Battery University

BU-204: How do Lithium Batteries Work?

Discover why lithium-ion is a superior battery system.

Pioneering work of the lithium battery began in 1912 under G.N. Lewis, but it was not until the early 1970s that the first non-rechargeable lithium batteries became commercially available. Attempts to develop rechargeable lithium batteries followed in the 1980s but failed because of instabilities in the metallic lithium used as anode material. (The metal-lithium battery uses lithium as anode; Li-ion uses graphite as anode and active materials in the cathode.)

Lithium is the lightest of all metals, has the greatest electrochemical potential and provides the largest specific energy per weight. Rechargeable batteries with lithium metal on the anode could provide extraordinarily high energy densities; however, it was discovered in the mid-1980s that cycling produced unwanted dendrites on the anode. These growth particles penetrate the separator and cause an electrical short. The cell temperature would rise quickly and approach the melting point of lithium, causing thermal runaway, also known as “venting with flame.” A large number of rechargeable metallic lithium batteries sent to Japan were recalled in 1991 after a battery in a mobile phone released flaming gases and inflicted burns to a man’s face.

The inherent instability of lithium metal, especially during charging, shifted research to a non-metallic solution using lithium ions. In 1991, Sony commercialized the first Li ion, and today this chemistry has become the most promising and fastest growing battery on the market. Although lower in specific energy than lithium-metal, Li ion is safe, provided the voltage and currents limits are being respected. (See BU-304a: Safety Concerns with Li-ion.)

Credit for inventing the lithium-cobalt-oxide battery should go to John B. Goodenough (1922). It is said that during the developments, a graduate student employed by Nippon Telephone & Telegraph (NTT) worked with Goodenough in the USA. Shortly after the breakthrough, the student traveled back to Japan, taking the discovery with him. Then in 1991, Sony announced an international patent on a lithium-cobalt-oxide cathode. Years of litigation ensued, but Sony was able to keep the patent and Goodenough received nothing for his efforts. In recognition of the contributions made in Li-ion developments, the U.S. National Academy of Engineering awarded Goodenough and other contributors the Charles Stark Draper Prize in 2014. In 2015, Israel awarded Goodenough a $1 million prize, which he will donate to the Texas Materials Institute to assist in materials research.

The key to the superior specific energy is the high cell voltage of 3.60V. Improvements in the active materials and electrolytes have the potential to further boost the energy density. Load characteristics are good and the flat discharge curve offers effective utilization of the stored energy in a desirable and flat voltage spectrum of 3.70–2.80V/cell.

In 1994, the cost to manufacture Li-ion in the 18650 cylindrical cell was over US$10 and the capacity was 1,100mAh. In 2001, the price dropped to below $3 while the capacity rose to 1,900mAh. Today, high energy-dense 18650 cells deliver over 3,000mAh and the costs are dropping. Cost reduction, increased specific energy and the absence of toxic material paved the road to make Li-ion the universally accepted battery for portable applications, heavy industries, electric powertrains and satellites. The 18650 measures 18mm in diameter and 65mm in length. (See BU-301: A look at Old and New Battery Packaging.)

Li-ion is a low-maintenance battery, an advantage that most other chemistries cannot claim. The battery has no memory and does not need exercising (deliberate full discharge) to keep it in good shape. Self-discharge is less than half that of nickel-based systems and this helps the fuel gauge applications. The nominal cell voltage of 3.60V can directly power mobile phones, tablets and digital cameras, offering simplifications and cost reductions over multi-cell designs. The drawbacks are the need for protection circuits to prevent abuse, as well as high price.

Types of Lithium-ion Batteries

Lithium-ion uses a cathode (positive electrode), an anode (negative electrode) and electrolyte as conductor. (The anode of a discharging battery is negative and the cathode positive (see BU-104b: Battery Building Blocks). The cathode is metal oxide and the anode consists of porous carbon. During discharge, the ions flow from the

anode to the cathode through the electrolyte and separator; charge reverses the direction and the ions flow from the cathode to the anode. Figure 1 illustrates the process.

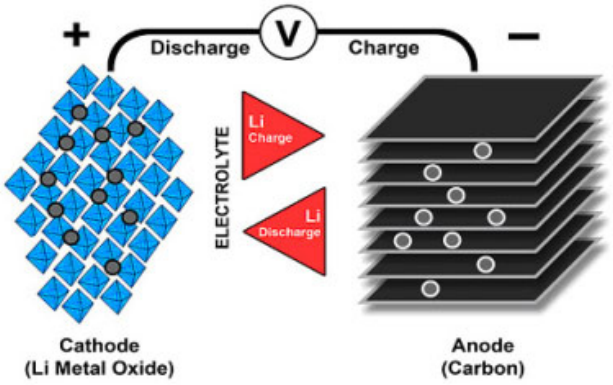

Figure 1: Ion flow in lithium-ion battery.
When the cell charges and discharges, ions shuttle between cathode (positive electrode) and anode (negative electrode). On discharge, the anode undergoes oxidation, or loss of electrons, and the cathode sees a reduction, or a gain of electrons. Charge reverses the movement.

Li ion batteries come in many varieties but all have one thing in common – the "lithium-ion" catchword. Although strikingly similar at first glance, these batteries vary in performance and the choice of active materials gives them unique personalities. (See BU-205: Types of Li-ion-ion.)

Sony's original lithium-ion battery used coke as the anode (coal product). Since 1997, most Li ion manufacturers, including Sony, shifted to graphite to attain a flatter discharge curve. Graphite is a form of carbon that has long-term cycle stability and is used in lead pencils. It is the most common carbon material, followed by hard and soft carbons. Nanotube carbons have not yet found commercial use in Li-ion as they tend to entangle and affect performance. A future material that promises to enhance the performance of Li-ion is graphene.

Figure 2 illustrates the voltage discharge curve of a modern Li-ion with graphite anode and the early coke version.

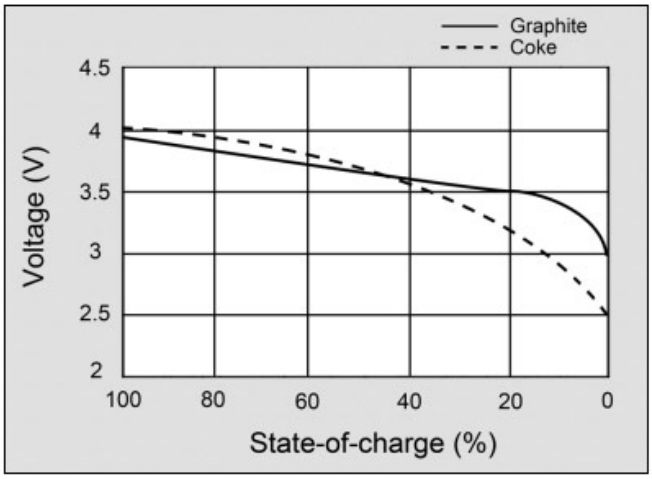

Figure 2: Voltage discharge curve of lithium-ion.
A battery should have a flat voltage curve in the usable discharge range. The modern graphite anode does this better than the early coke version.
Courtesy of Cadex

Several additives have been tried, including silicon-based alloys, to enhance the performance of the graphite anode. It takes six carbon (graphite) atoms to bind to a single lithium ion; a single silicon atom can bind to four lithium ions. This means that the silicon anode could theoretically store over 10 times the energy of graphite, but expansion of the anode during charge is a problem. Pure silicone anodes are therefore not practical and only 3–5 percent of silicon is typically added to the anode of a silicon-based to achieve good cycle life.

Using nano-structured lithium-titanate as an anode additive shows promising cycle life, good load capabilities, excellent low-temperature performance and superior safety, but the specific energy is low and the cost is high.

Experimenting with cathode and anode material allows manufacturers to strengthen intrinsic qualities, but one enhancement may compromise another. The so-called "Energy Cell" optimizes the specific energy (capacity) to achieve long runtimes but at lower specific power; the "Power Cell" offers exceptional specific power but at lower capacity. The "Hybrid Cell" is a compromise and offers a little bit of both. (More on BU-501: Basics About Discharging.)

Manufacturers can attain a high specific energy and low cost relatively easily by adding nickel in lieu of the more expensive cobalt, but this makes the cell less stable. While a start-up company may focus on high specific energy and low price to gain quick market acceptance, safety and durability cannot be compromised. Reputable manufacturers place high integrity on safety and longevity. Table 3 summarizes the advantages and limitations of Li-ion.

Most Li-ion batteries share a similar design consisting of a metal oxide positive electrode (cathode) that is coated onto an aluminum current collector, a negative electrode (anode) made from carbon/graphite coated on a copper current collector, a separator and electrolyte made of lithium salt in an organic solvent. Table 3 summarizes the advantages and limitations of Li-ion.

Advantages	High specific energy and high load capabilities with Power Cells Long cycle and extend shelf-life; maintenance-free High capacity, low internal resistance, good coulombic efficiency Simple charge algorithm and reasonably short charge times Low self-discharge (less than half that of NiCd and NiMH)
Limitations	Requires protection circuit to prevent thermal runaway if stressed Degrades at high temperature and when stored at high voltage No rapid charge possible at freezing temperatures (<0°C, <32°F) Transportation regulations required when shipping in larger quantities

Table 3: Advantages and limitations of Li-ion batteries

Last Updated 2018-06-01

*** Please Read Regarding Comments ***

Comments are intended for "commenting," an open discussion amongst site visitors. Battery University monitors the comments and understands the importance of expressing perspectives and opinions in a shared forum. However, all communication must be done with the use of appropriate language and the avoidance of spam and discrimination.

If you have a suggestion or would like to report an error, please use the "contact us" form or email us at: BatteryU@cadex.com. We like to hear from you but we cannot answer all inquiries. We recommend posting your question in the comment sections for the Battery University Group (BUG) to share.

Or Jump To A Different Article

Basics You Should Know

Introduction

- BU-001: Sharing Battery Knowledge
- BU-002: Introduction
- BU-003: Dedication

Crash Course on Batteries

- BU-101: When Was the Battery Invented?
- BU-102: Early Innovators
- BU-103: Global Battery Markets
- BU-103a: Battery Breakthroughs: Myth or Fact?
- BU-104: Getting to Know the Battery
- BU-104a: Comparing the Battery with Other Power Sources
- BU-104b: Battery Building Blocks
- BU-104c: The Octagon Battery – What makes a Battery a Battery

- BU-105: Battery Definitions and what they mean
- BU-106: Advantages of Primary Batteries
- BU-106a: Choices of Primary Batteries
- BU-107: Comparison Table of Secondary Batteries

Battery Types

- BU-201: How does the Lead Acid Battery Work?
- BU-201a: Absorbent Glass Mat (AGM)
- BU-201b: Gel Lead Acid Battery
- BU-202: New Lead Acid Systems
- BU-203: Nickel-based Batteries
- BU-204: How do Lithium Batteries Work?
- BU-205: Types of Lithium-ion
- BU-206: Lithium-polymer: Substance or Hype?
- BU-208: Cycling Performance
- BU-209: How does a Supercapacitor Work?
- BU-210: How does the Fuel Cell Work?
- BU-210a: Why does Sodium-sulfur need to be heated
- BU-210b: How does the Flow Battery Work?
- BU-211: Alternate Battery Systems
- BU-212: Future Batteries
- BU-214: Summary Table of Lead-based Batteries
- BU-215: Summary Table of Nickel-based Batteries
- BU-216: Summary Table of Lithium-based Batteries
- BU-217: Summary Table of Alternate Batteries
- BU-218: Summary Table of Future Batteries

Packaging and Safety

- BU-301: A look at Old and New Battery Packaging
- BU-301a: Types of Battery Cells
- BU-302: Series and Parallel Battery Configurations
- BU-303: Confusion with Voltages
- BU-304: Why are Protection Circuits Needed?
- BU-304a: Safety Concerns with Li-ion
- BU-304b: Making Lithium-ion Safe
- BU-304c: Battery Safety in Public
- BU-305: Building a Lithium-ion Pack
- BU-306: What is the Function of the Separator?
- BU-307: How does Electrolyte Work?
- BU-308: Availability of Lithium
- BU-309: How does Graphite Work in Li-ion?
- BU-310: How does Cobalt Work in Li-ion?
- BU-311: Battery Raw Materials

Charge Methods

- BU-401: How do Battery Chargers Work?
- BU-401a: Fast and Ultra-fast Chargers
- BU-402: What Is C-rate?
- BU-403: Charging Lead Acid
- BU-404: What is Equalizing Charge?
- BU-405: Charging with a Power Supply
- BU-406: Battery as a Buffer
- BU-407: Charging Nickel-cadmium
- BU-408: Charging Nickel-metal-hydride
- BU-409: Charging Lithium-ion
- BU-409a: Why do Old Li-ion Batteries Take Long to Charge?
- BU-410: Charging at High and Low Temperatures
- BU-411: Charging from a USB Port
- BU-412: Charging without Wires
- BU-413: Charging with Solar, Turbine
- BU-413a: How to Store Renewable Energy in a Battery
- BU-414: How do Charger Chips Work?
- BU-415: How to Charge and When to Charge?

Discharge Methods

- BU-501: Basics about Discharging
- BU-501a: Discharge Characteristics of Li-ion
- BU-502: Discharging at High and Low Temperatures
- BU-503: How to Calculate Battery Runtime
- BU-504: How to Verify Sufficient Battery Capacity

"Smart" Battery

- BU-601: How does a Smart Battery Work?
- BU-602: How does a Battery Fuel Gauge Work?
- BU-603: How to Calibrate a “Smart” Battery
- BU-604: How to Process Data from a “Smart” Battery
- Close Part One Menu

The Battery and You

From Birth to Retirement

- BU-701: How to Prime Batteries
- BU-702: How to Store Batteries
- BU-703: Health Concerns with Batteries
- BU-704: How to Transport Batteries
- BU-704a: Shipping Lithium-based Batteries by Air
- BU-704b: CAUTION & Overpack Labels
- BU-704c: Class 9 Label
- BU-704d: NFPA 704 Rating
- BU-705: How to Recycle Batteries
- BU-705a: Battery Recycling as a Business
- BU-706: Summary of Do’s and Don’ts

How to Prolong Battery Life

- BU-801: Setting Battery Performance Standards
- BU-801a: How to Rate Battery Runtime
- BU-801b: How to Define Battery Life
- BU-802: What Causes Capacity Loss?
- BU-802a: How does Rising Internal Resistance affect Performance?
- BU-802b: What does Elevated Self-discharge Do?
- BU-802c: How Low can a Battery be Discharged?
- BU-803: Can Batteries Be Restored?
- BU-803a: Cell Matching and Balancing
- BU-803b: What causes Cells to Short?
- BU-803c: Loss of Electrolyte
- BU-804: How to Prolong Lead-acid Batteries
- BU-804a: Corrosion, Shedding and Internal Short
- BU-804b: Sulfation and How to Prevent it
- BU-804c: Acid Stratification and Surface Charge
- BU-805: Additives to Boost Flooded Lead Acid
- BU-806: Tracking Battery Capacity and Resistance as part of Aging
- BU-806a: How Heat and Loading affect Battery Life
- BU-807: How to Restore Nickel-based Batteries
- BU-807a: Effect of Zapping
- BU-808: How to Prolong Lithium-based Batteries
- BU-808a: How to Awaken a Sleeping Li-ion
- BU-808b: What Causes Li-ion to Die?
- BU-808c: Coulombic and Energy Efficiency with the Battery
- BU-809: How to Maximize Runtime
- BU-810: What Everyone Should Know About Aftermarket Batteries

Battery Testing and Monitoring

- BU-901: Fundamentals in Battery Testing
- BU-902: How to Measure Internal Resistance
- BU-902a: How to Measure CCA
- BU-903: How to Measure State-of-charge
- BU-904: How to Measure Capacity
- BU-905: Testing Lead Acid Batteries
- BU-905a: Testing Starter Batteries in Vehicles

- Charging without Wires — A Solution or Laziness
- What everyone should know about Battery Chargers
- A Look at Cell Formats and how to Build a good Battery
- Battery Breakthroughs — Myth or Fact?
- Rapid-test Methods that No Longer Work
- Shipping Lithium-based Batteries by Air
- How to make Batteries more Reliable and Longer Lasting
- What causes Lithium-ion to die?
- Safety of Lithium-ion Batteries
- Recognizing Battery Capacity as the Missing Link
- Managing Batteries for Warehouse Logistics
- Caring for your Starter Battery
- Giving Batteries a Second Life
- How to Make Batteries in Medical Devices More Reliable
- Possible Solutions for the Battery Problem on the Boeing 787
- Impedance Spectroscopy Checks Battery Capacity in 15 Seconds
- How to Improve the Battery Fuel Gauge
- Examining Loading Characteristics on Primary and Secondary Batteries

Language Pool

- BU-001: Compartir conocimiento sobre baterías
- BU-002: Introducción
- BU-003: Dedicatoria
- BU-104: Conociendo la Batería
- BU-302: Configuraciones de Baterías en Serie y Paralelo

Batteries in a Portable World

- Change-log of “Batteries in a Portable World,” 4th edition: Chapters 1 - 3
- Change-log of “Batteries in a Portable World,” 4th edition: Chapters 4 - 10
- Close Part Three Menu

Comments (54)

On June 22, 2011 at 12:20am

omanial wrote:

this subject is very important and necessery

On June 22, 2011 at 12:25am

zaid salim Al-saidi wrote:

Ilike this subject and it is very important also so necessery for university students

On August 4, 2011 at 10:05pm

Ruel Hernandez wrote:

Very informative and also important for electricians like me.
thanks.

On December 2, 2011 at 3:34pm

Alex wrote:

Please include refs in all of the statements cuz I knew this “Attempts to develop rechargeable lithium batteries followed in the 1980s” is not true. It is actually started from 1972 Whittingham working at EXXON developed rechargeable LIBs based on Li metal and TiS2 and his work was published on Science in 1976.
“http://www.sciencemag.org/content/192/4244/1126”

On December 5, 2011 at 12:36pm

Oleg Lyan wrote:

Very helpful for my project at SDU designing a battery system for Formula Student Electric and making presentations and to get the basic idea of what Li-ion battery is…

On December 25, 2011 at 9:44pm

lungu costelini wrote:

hi please hepp me i need 3,6v-3,7v rechargeble a verry smole size whit 10-15 mah the button cell dont work is to big my space in my aplications is not more then 25mmL/5mm l or w i m luking for a cylindrical batterys or may by button cell but not more then 6mm/6mm ,and a charger to go whit that ,if some one have them in stoke or anny idea please contact me at grigoregreen@yahoo.com

On April 2, 2012 at 8:09am

peter de laere wrote:

Can making fuel out of electriity be promissing as well? I read something about making CO from CO2 and then using CO to compose all kinds of organic fuel. At least the specific energy would be huge compared to batteries.
It will not be useful for small equipment but for energy buffering it might be the solution.
How are evolutions for that kind of energy storage?

On May 3, 2012 at 2:02pm

Marco wrote:

hi,
which is the difference between LiNiMnCoO2 and LiNiCoMn2O4.
Thank you.

On June 13, 2012 at 4:58am

Valentin Lecuyer wrote:

Hi everyone,
Does anyone knows how to detect the SoC of a CR2 (lithium primary battery) without knowing its initial characteristics?

Thank You

On November 12, 2012 at 10:38am

Dr Addie Noye wrote:

I need regular information. i also want to know how to calculate energy cycle life.

On March 4, 2013 at 6:04pm

Sergio Pasquarelli wrote:

This is probably a stupid question, but if the lithium cells are 3.6v, how can anyone make a 9v lithium battery? I would have thought it be, either 7.2v or 10.8v? Far from the 9v or even 8.4v advertised on various 9v lithiums.

On March 11, 2013 at 2:22am

Sharat Kalapa wrote:

In Table 3: “Characteristics of the four most commonly used lithium-ion batteries” there is a typo in the Cost row for Li-manganese

On April 3, 2013 at 2:25pm

Elliott Olson wrote:

If Li-ion batteries don’t need exercise to condition them, why wouldn’t a Black & Decker hand-crank flashlight I have with Li-ion battery not hold a charge for even a half day until I exercised it (daily charging) for at least a couple weeks?

On April 22, 2013 at 9:23pm

Rob Davidowitz wrote:

Referring to charging and monitoring LiPo batteries.

I am currently using a 2200Mah, 40-50C 11.1V batteries to fly my 450 helicopter and foam trainer
I use the I Charger 208b to recharge these batteries
I have flown 30 flights on a battery
I have been doing an individual 1C balance charge on each of my batteries after every flight and I try very hard to never fly any of the cells down below 90% of the voltage capacity.
I use 11.34V as my “fly to lower limit”
There have been a few, but very few, times that I have taken 1 or 2 batteries down to ±11.2V but no lower than that.
So I think I am being quite conservative and careful with these batteries. “I think” I might be wrong.

My questions:
1: I believe that it is not a good idea to charge after every flight but rather leave the batteries at ± 3.5 -3.7V per cell and rather charge fully just before flying again. Is this correct?

2: Is it a good idea to store these semi charged batteries in a fridge until just before use.

3: I have been monitoring the IR. of each cell after each flight and then again after each charge. I have been told that there is no benefit in measuring IR after a flight and should only measure after a charge at which point the individual IR readings of each cell should be close to the same. Is this correct and if so, how close to each other should these readings be and at what value of IR should I be suspecting a failing battery?

4: Is 90% being too conservative or should I be flying down to 80%?

Thank you in advance.
Rob

On June 5, 2013 at 5:55am

Javier wrote:

Hello

Does anyone know what is an electrolitic wetter, used in the Li-ion batteries manufacturing?

Thank you

j.

On November 21, 2013 at 11:59pm

aishwarya wrote:

Can any one please tell me how should i calculate the efficiency of li-ion battery?

On January 17, 2014 at 11:37am

Anthony wrote:

Can you please explain your units for specific power? Specific power normally has the units of W/kg, so power per mass. However, you have it in C, which I assume stands for coulombs, which is unrelated.

On March 19, 2014 at 8:53am

John wrote:

In the second para following Fig 1 you say
“Lithium-ion has a theoretically capacity of about 2,000kWh.”
I think this should read 2,000kWh/kg?

On April 22, 2014 at 12:14am

naga rajum wrote:

my q is >> what is the relation between charging time, voltage , capacity, charging current in lithium ion rechargeable battery.
suppose how much time it will take 6000mah battery charging with 100mA with 4.2 volts.

On July 4, 2014 at 6:00pm

Charles P wrote:

It has been my experience that Li-ion cells that are never charged eventually enter a high resistance state and are ruined.
I suspect this damage is caused by low voltage. It may be that the high resistance state is proceeded by a internal discharge state which can reduce the voltage to zero in a few weeks.
I would like to know the chemical and theoretical basis for this characteristic and especially voltages.
I have known good cells that can go a half year or maybe a year on the shelf without significant discharge. These had the safety circuit removed. I am having a hard time finding the schematics for laptop interfaces and safety circuits.

On July 7, 2014 at 1:00pm

Mohammad wrote:

Does any body know what is the chemistry of LG chem 18650 MG1 2900 Ah battery? What does MG1 stands for?

Thanks

On July 17, 2014 at 1:28am

lexi wrote:

if you want to know the cylce life of battery pack,you need a BMS with LCD .
www.leadyo-batttery.com

On August 15, 2014 at 9:45pm

Rob Davidowitz wrote:

I am trying to find an accurate method of determining the REAL usable capacity in mAh of my 3300mAh 6s LiPo.

My situation this far.

I need to accurately know what the real mAh capacity of the LiPo is for endurance calculation and primarily to be able to dial in the correct value for each individual pack into my telemetry for a specific flight with a specific battery pack.

What with age, deterioration and abuse, I understand that the capacity printed on the battery is just a guideline and rarely the real capacity of the pack. I am therefore treating this number as a starting point.

So! - a typical scenario just flown.

Pack fully charged before flight and according to my various devices readings:

iCharger indicates Pack Voltage: 25.2V

HK-010 power analyser indicates 99% capacity. I might be wrong, but I think this device calculates capacity based on Voltage and not Amperage - in which case this would not be what I am trying to achieve.

Based on previous flights time trials, I have 3000mAh dialled into my telemetry because I have simply taken the rated capacity and reduced it by 10% and I have my ‘end flight warning’ set at 25% of this 3000mAh value which has always been on the safe side of things for me. Not as accurate as I would like.

After flight, the wattmeter that I have plugged in for the flight, shows Vm 21.71V and 2355mAh used. All good and well, but I still don’t know what the starting capacity was.
HK-010 power analyser indicates 32% capacity.

So now back to the charger where the charge required to re-fill the pack as 2400mAh. Value corresponds with wattmeter reading. I know I can do a calculation based on capacity used as a percentage of the rated capacity and multiply this with the time flown and get a “Rated Capacity endurance” but I know that this is not correct because the rated capacity and actual capacity are 2 different values. ie. Have I just used 2355/3300 or 2355/3000 or 2355/(what value)?

As it is, 3300-2400=900 and 900 expressed as a percentage of 3300 is 27%. Calculation based on my estimated real capacity of 3000mAh. 900 as a percentage of 3000 is 30% which is closer the HK-010 reading but this may just be coincidental for all I know.

I am also aware that the 3 different devices I am using will in all probability not be calibrated equally and that there will be discrepancies in the values. I need to understand which value to trust and use to ultimately get to the REAL capacity of this battery pack.

Thank you in advance for your assistance.
Rob

On August 15, 2014 at 9:58pm

Trupti wrote:

Thank u so much for such a wonderful work !! Your notes are too good.
Here I would like to ask one basic question ... why people dont use Water as an electrolyte for li ion battery ?

On September 18, 2014 at 12:30am

Ghassan wrote:

Hello sir
I am a mechanical engineer and interested in hybrid vehicles, but I lack some information about the types of traction batteries used in these vehicles, whichever is best
Please provide me with information and features of each type and cons of each type and what are the most spread of the battery and safety in the use of this type of batteries

On October 1, 2014 at 12:17am

Niroshana wrote:

Much thankful if educated about hybrid car batteries and its functions

On October 17, 2014 at 3:24am

gerald wrote:

It is safe when you don't full charge a battery and unplug it from the charger?

On November 11, 2014 at 6:17pm

Edward wrote:

Hi gerald, yes ,that is safe no full charged for lithium-ion battery,

On December 23, 2014 at 10:37am

mark wrote:

Can someone explain how brand new li-po batteries can sit on store shelves and not require to be charged to prevent full discharge but batteries used have to be stored at 40% and in time checked and brought back up.
Or do you run the risk that you buy bad new old stock?
My situation is I have music remote that uses a 3.7 V 300 mA battery part PL422042 which I can only find listed on one web page. I dont know how long he will have them and do not know how long he has had this stock. It would seems if not used they have a long shelf life right? They offer to upgrade the remote and firmware which i need to do so figured I would have them replace the dead battery. My other option is not to allow them to install the batter and do it mself later which will require to open the case and solder it. But I suspect they can not upgrade without the new battery so I am stuck with having a new one installed. HOWEVER I dont plan on using this as my primary , This will be my back up system.
So I wanted to know if there was a way to prolong the life of the battery without having to pull it out and charge it every week? (as the batteries I see for sale I am sure are not being changed up.)
This is not my area of expertise so am coming to be schooled at Battery U. Thanks

On January 14, 2015 at 4:27pm

Tharindu Kariyawsam wrote:

In the Table 3, what should be the cost for Li-manganese?

On February 9, 2015 at 12:32am

Lakshmi wrote:

Hi..
I am doing my Ph.D in Li-ion batteries.
Could anyone please tell me the exact formula for calculating specific capacitance of my material from CV-curve. I want my answer in mAh/g. Anyone please do the needful for me..

On February 9, 2015 at 8:37am

Ashu wrote:

What are the current technical issues in LMR NMC Cathode Material?

And what are the approaches being considered to solve these issues?

On March 6, 2015 at 4:54am

mansour bahrami wrote:

Hi
I'm designing an electric motor-cycle and intensively I need information listed below about Li-Ion batteries, that would be my pleasure if you answer me or direct me somewhere to get these information.
type of Li-ion batteries used for this case , cell size , weight , capacity , price , manufacturer , ...
thank you

On March 6, 2015 at 8:03pm

Edward wrote:

mansour bahrami , you can email to me zzrm316@163.com I will tell you the detail information

On April 23, 2015 at 1:47pm

josh wrote:

this was a great and helpful tool as I am studying level 3 engineering at college and this was one of the assignments and gave out clear and accurate information

On April 30, 2015 at 11:33pm

William Hughes-Games wrote:

I didn't see a graph on battery life vs depth of discharge at each cycle. A battery in which you can use all the energy it stores at each cycle without shortening its life will have a great advantage.

On June 30, 2015 at 10:51pm

kotreshi c k wrote:

i want features of lithium ion batteries…..could you help you for this

On February 10, 2016 at 3:18am

Martijn Gevaert wrote:

i saw someone asking why li-ion batteries don't use water as an elektrolyte.
The reason for this is that lithium reacts very violantly with water. It's one of the biggest challenges in li-ion that they can't use elektrolytes wich hold water.

On July 8, 2016 at 10:32pm

patricia wrote:

hello really need info im a dummy on 4g my own plan and samsung3 first 4g wont hold a charge new phone and samsung3 wont hold charge if 4g phone and obama free phone apears the batterys dont match the phones and if i read right.if ur batterys drane from full to 5 minits texting.something is running draning energry??? how can u tell if someone changed batterys how can u tell if the batterys are not or is harmfull??? and gets hot within minits,and light is low ans set to enery saver??? my samsung was a gift is there batterys in my samsung?if so,how to get to battery?how again do i know it is right battery it seems im saying my ex is exstreamly elictry smart,my samsung3 drans as im on facebook typing for exsapal,t blinks in and out and boom it says hook up chager,the cell phones blink and same,hook chager up,so if i have a hater and hes a hacker,and switching batterys,am i safe or just waiting for all to exsplode???? and on my samsung i have the 34g memory card so if u could ancer,plz do it in tearms i understand,i a dummy thank you

On July 20, 2016 at 10:36am

Mohsen Irani wrote:

hello , thank you for your great website and your articles; is there any PDF eBook published from your campaigns here? i want to print all of them because i can't use the PC for long time cuse of my eye problems.
thank you again.
if possible and if the PDF is Available please email me.

On October 10, 2016 at 12:15pm

Doug Eaton wrote:

BTW: John Goodenough was born in 1922 and didn't do his work with LI batteries until 70s.

On October 30, 2016 at 8:53am

Saif Al-agele wrote:

Hi, i want to calculate the weight cell for Li-ion battery but i cant find an equation to help me to my calculation and how i can calculate the weight for a batter give me !0 MW?

On December 5, 2016 at 5:59am

prabhu wrote:

In lithium iron battery i have set a voltage of 598V as a DC bus voltage reference, but it increased to 611V, so what could be reason to increase the voltage.

On December 31, 2016 at 6:51am

Lotfi wrote:

Hi dear
How long can be kept without using lithium-ion batteries

On January 24, 2017 at 12:20am

Rajaram mohan wrote:

Is there any chance by which li-ion batteries could explode?
And I do have another question
Charging battery overnight continuously - is it good for the health of the battery

On January 30, 2017 at 6:55am

F Eggleston wrote:

How do High and low temperatures affect the output of Li and other batteries

On June 29, 2017 at 1:48am

Allan wrote:

its so helpful, a lot of informations would be use in day to day activities

On August 3, 2017 at 1:23am

Dexterwise wrote:

I never knew li-lion batteries were of different types.

On December 4, 2017 at 1:34pm

Sam wrote:

Hi, i am using Lithium Ion Polymer Battery - 3.7v 500mAh on one of my circuits.I don't think the battery is inflated because i tried connecting a simple LED light to check if that blinks and it blinked. But the battery is not delivering charge to the device because the device is not giving output whenever i switch on the device.
Can anyone suggest anything here.

On April 12, 2018 at 10:32am

phil wrote:

The battery that came with my camera is a 4.35V, 1800mAh rechargeable Lithium battery. if I use a 3.75 2,600nAh 962 WH rechargeable Lithium battery what is the difference. What effect could or will it have on the performance of my camera. Will it harm the electronics in my camera?

On April 16, 2018 at 12:33am

o.raja mohan reddy wrote:

I am trying to prepare aluminium-air batteries. It is a non-rechargeable type. what are best possible casing and cell arrangement to replace the anodes once it is exhausted ?

On August 9, 2018 at 8:58pm

Rich Marcon wrote:

We are True Health Diagnostic based in Frisco, TX and would like you to provide us with a detail quote in
4D 250 AH , 100 AH, 120 AH,...batteries.Or ALKALINE BATTERIES.

Also for comparison sake, please mention the prices of the products of some other leading brands you have in stock as well.

We will look forward to your prompt response

On October 17, 2018 at 9:48am

Robert Germscheid wrote:

What does a HETP designation mean if anyting in newer chemistry. I've seen the designation as a New technology in a sales brochure?

On November 17, 2018 at 6:53pm

Gumtree User jim wrote:

does it do any harm charging lithium-ion battery when its still half full