How To Recondition Batteries

The Complete Story

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Disclaimer

Legal stuff our lawyers made us say. Let's get this out of the way first, so we can get to the good stuff…

No Part of this document shall be reproduced or resold without permission from the authors. Violators will be prosecuted to the fullest extent of the law. The authors of this book assume no responsibility for accidents incurred while following the enclosed directions.

There is always a certain amount of risk involved in any human building project. The following plans have worked for others in the past, but we assume no financial or legal responsibility should you not follow the directions exactly.

Please be careful. These instructions as recorded have worked for others in the past and should work for you too. Use this document at your own risk. We know you can do this, as we have done all of the things outlined in this book, and many others have too.

But if you are for any reason not comfortable with the procedures then ask a competent trades person (electrician) to assist you. Or, Contact us at our website and we will help you.

The building advice given in this book is up to date and as accurate as we could possibly find. Of course, some (experts?) will disagree with our findings. That is fine. We know this system works and it will work for you. Of course as with any lifestyle change it does take time. We don't believe in providing anything but the best advice we can. We want you to succeed and following the plan that has worked for our family for over 30 years and for other families is a great place to start.

Don't be afraid to contact us about anything. Send us an email at EarthPowerNews@gmail.com **If you don't understand something, just send us an email. We promise to respond promptly.**

This book is intended to be easy to read and easy to navigate.

Our purpose is to provide you with the very best guidance learning how to recondition batteries at home.

This text is designed to be read from cover to cover, step by step in order to achieve that goal. You can bookmark later for your own reference, but for now read the whole thing.

You will notice a number of text links that appear in blue, just like the preceding one, throughout the book. For those of you not familiar with text links, just by clicking on them, they will take you directly to a web page on the internet for you to read, or to a bookmarked section of this book.

*** ***You have to be connected to the internet when you are viewing the document for the text links to work.***

IMPORTANT***

Please Read This First

If you have any Problems, Questions or Concerns about this book, please contact us immediately.

You can send me a personal email at EarthPowerNews@gmail.com

We want you to know that you are important to us. Your success is important to us. That makes your questions important to us.

Your total satisfaction with this book is our aim.

Please remember that it does take some time to digest new information. There are times when it takes me 2 or even 3 times reading a book before I 'get it'.

You are not alone if you don't get it the first time through. This can be a very complicated subject to understand, especially if it is new to you. Take your time and let us help you if you need it.

We are here to help you and we will walk you through every step if you need us to.

This manual was compiled from our own experience and the experience of many others who have contributed to the overall design and function of this the 6th edition of this book. Many thanks to our friends and neighbors who have provided advice that made this book and the accompanying plans better.

Safety First

Batteries can be dangerous if you don't follow some very simple safety precautions.

1. Do not freeze or overheat batteries
2. Always wear safety gloves (rubberized) when handling batteries
3. Wear proper Eye protection
4. Make sure you never wear jewellery, especially rings which can conduct electricity when handling batteries
5. Never ever connect the negative and positive leads on a battery, it will short out and could overheat and cause serious damage or injury.

6. When using a multimeter always connect it to the positive lead to the positive side of the battery, and conversely the negative lead to the negative side of the battery
7. Always work in a well ventilated area, garages or even outdoors work best.

Introduction

The first Rechargeable battery we ever owned was in a cordless drill we bought many years ago. It was a marvel to not have to plug it in to work around our home, only to plug it in.

Today, rechargeable batteries are found in many different places, in boats, renewable energy systems, golf carts, power tools, computers, cordless phones, cell phones and hundreds of other applications.

The only problem is that the darn batteries are always wearing down, failing to charge or in general just not working the way they should. What should you do? You can recondition all of your rechargeable batteries, and this guide book will show you how.

First we are going to start with a bit of education, then we will move right

into the plans for building your own battery reconditioner. And please remember we are always here to help you if there is something you just don't understand.

We will show you how to test your batteries properly to know exactly what is wrong, and judge the useful life of your batteries so you get your money's worth every time.

Our family uses deep cycle batteries in our renewable energy system, to store power produced by our wind generators and solar panels.

We also use small AA and AAA rechargeable batteries for flashlights, TV remotes, and even our electric razor, even battery application can use a rechargeable. It just makes sense to recharge and not always have to throw away those alkaline batteries. What a waste... not to mention the environmental hazard.

And lastly we will show you where to find batteries you can use in your reconditioning program that are completely free, and how to start a very profitable business reconditioning batteries for other people.

Why Should You Recondition Batteries?

Don't you just love when something you buy is new. Turn the key and the car starts everytime. Plug in the cordless drill and it charges right up. Plug in the camera battery and it is charged in an hour, just like it is supposed to.

But then something happens...
One morning the car does not start, the battery is dead. You pick up the remote and it says 'Low Battery', even after you charged it. The camera takes all night plugged in to charge, and just does not work like it used to... when it was new.

This process usually takes a couple years, but the inevitable happens, the battery just won't hold a charge and you think the device (sometimes very expensive device) needs to be fixed. But how?

Lots of times the old battery is simply discarded and you buy a new one. In many cases, by following the directions in this book you could have reconditioned the offending battery and bring it back to almost new condition, a second life if you will.

For smaller rechargeable batteries this process usually takes place because of something called the 'memory effect'. NiCd, or Nicad batteries as they are commonly referred to are most susceptible to this process. One important factor in preventing the memory effect is to completely discharge the batteries occasionally. Not every time, but every now and then to completely run the device until it shows a completely dead battery and then recharge it.

This, in essence causes the battery to form a new 'memory' of the the charge and discharge cycle, thereby allowing it to charge more fully. If you charge and discharge your batteries the same everytime, they will develop the 'memory effect' and their useful life will be greatly limited.

Most of us will plug in a battery to be recharged when it is only about half way discharged. Unfortunately, the battery will remember this, by forming a simple growth of the crystals used to form it in the factory. Some of the battery is never used when you only cycle it half way.

It is a fairly complicated chemical process why it happens. What is important is for you to cycle your rechargeable batteries to empty occasionally. More important, this process can be reversed by using the techniques outlined in this book.

Another important facet of this whole subject is proper battery care.

Learning how to properly care for your batteries will dramatically increase their useful life.

Have you ever jumped in your car, turned the key and heard that familiar clicking sound... a dead battery... usually miles away from home. Automobile batteries die too, but for different reasons than NiCad batteries, they do not suffer from the memory effect.

The reason lead acid (automobile) batteries die is because of sulfation, a build up of sulfate on the inside plates of the interior of the battery. The good part is that using the techniques we describe later you will learn a process called desulfation.

We will also show you how to build a Desulfator, or Battery Reconditioner as most people know it by. In this way you will be able to recondition your own car, and deep cycle batteries.

You will learn the differences between each type of battery too, deep cycle, and lead acid, Nicad etc.

What is important here is that you will never ever be without the knowledge of how to care for your batteries and renew them when they are no longer performing upto par. You will be able to recondition them.

Types of Batteries: Rechargeable, Nicad, Deep Cycle

Rechargeable batteries such as you find in simple electronic products like computers, cell phones and the like come in 3 basic types: we already spoke of Nicad or Nickel Cadmium, which are very popular but there are 2 others that are making headway into the marketplace and you may encounter these as well. There is NiMH or Nickel Metal Hydride batteries

and the newer Lithium Ion , or LiIon batteries. The later are finding their way into the newer power tool market because they charge quickly and are lighter than Nicad batteries. Let's talk about each type in a bit more detail...

Nicad Batteries

Nicad batteries, we have been using for the longest. They have been the leader in this type of battery for years. The nice thing about them is that they hold a very constant voltage so the electric devices they run do not burn out. They also hold a charge very well, and their life expectancy is very good. But, as mentioned earlier they do suffer from the memory effect, and as such, if not properly cared for will only last a couple years, although we have had some that lasted well over 10, such as my older dewalt drill. One of the batteries died after 1 and a half years, the other has lasted as mentioned over 10 years. We did fix the offending one and it has performed much better now.

NiMH or Nickel Metal Hydride Batteries

NiMH batteries are a bit newer than Nicad batteries, and show a lot of promise. The major development here is that they rarely suffer from the memory effect. There is some, but because of the different chemical makeup it is much decreased, which is good for the average consumer. One very important asset of these batteries is that they definitely last longer, allowing you to charge and discharge them many more times. Probably double or even triple the life of Nicad batteries. They do cost a bit more, but not double, so the extra lifespan more than makes up for it.

Lithium Ion, LiIon Batteries

We really like these as mentioned earlier. Recently we purchased a Makita cordless drill with Lithium batteries. It is lighter, stronger, and charges faster than any Nicad batteries we have ever used. Lithium batteries also have a much longer lifespan, lasting over 10 years easily. Another nice thing about this new technology is that they do not suffer from the memory effect hardly at all. They may lose 5% of their capacity each year, but that is not bad. A good investment we think.

Or the lithium cell phone battery shown above, it lasts a long time between charges, and as you can see by the old style phone it has kept going a long time.

Proper Care for Your Rechargeable Batteries

How do you properly care for your rechargeable batteries so you get your money's worth, and make them last as long as possible?
There are some very obvious things you can do, but since each battery type is different we will discuss each in turn and discuss proper care for each.

Nicad Batteries

Most of your efforts to care for your nicad batteries should be geared towards lessening the 'memory effect'. What follows are our recommendations on what you should do to counter this effect.

- It may seem like the wrong thing to do, and contrary to everything

we have been taught, but you should use your nicad battery devices until the battery is completely drained and then recharge it.

- When you first purchase your Nicad batteries, they should be fully discharged and completely charged again for the first 5 charging cycles.
- Keep your Nicad batteries at or near room temperatures.
- Never overcharge your Nicad batteries, don't leave them on the charger past the time they are charged, as it can easily damage them.
- Use a charger with a good indicator light and one that shuts off automatically when the battery is charged, as this will prevent overcharging

NiMH Batteries

NiMH batteries are a bit different and do not suffer as much from the memory effect, but they do drain down very fast when not in use. Here is the proper care guidelines for them.

- If left unused for a few weeks, you should recharge your NiMH batteries before use, try not to use it if it is run down
- Never leave these batteries in your electrical device while it is turned on, and the battery is dead, you can actually reverse the polarity, which will cause the device to run backwards when the battery is recharged.
- These batteries can more easily be damaged by high temperatures so be careful where you store and use them.

- Find a good charger that shuts off when charging is complete to avoid overcharging

Lithium Ion Batteries

Since Lithium batteries do not suffer from the memory effect their care is somewhat different from the other 2 types. Here is what you should do.

- About once per month fully discharge the battery and recharge it fully before use
- Try and keep the battery on the charger at all times when not in use, this will reduce any damage and will prolong its life substantially.
- High temperatures can damage these batteries, be careful

Equipment and Supplies You Need

When you first begin caring for and reconditioning your batteries there are

only a few items that you really need. The first one is a simple multimeter (shown above) that is used to test the current and voltage of your batteries. It is a simple device to operate and you will have no trouble learning how to use it. Next, you need a set of alligator clips, just simple wires with clips on each end for both the negative and positive leads.

And let's not forget safety, please use your safety glasses at all times, they are inexpensive and reliable.
Please do not work without them, you are only given one set of eyes...

All of this should not cost you more than $20 or thereabouts, so it is not a huge investment. If you are looking for a decent multimeter you shop for one here at this link Digital Multimeters (click here)

If you are looking at getting more involved in battery reconditioning, or considering this as a business then you will also want a battery tester, or even a battery analyzer.

How to Test Your Batteries

All of the above mentioned devices can be used to test your batteries, a multimeter, battery testers or a battery analyzer can be used. Let's start with the simplest method (and the least expensive). It is very accurate as well.

Testing Your Batteries with a Multimeter

You can use your multimeter for many different applications. You can test DC current, which flows in your batteries. You can test AC current, like is in your house. You can test resistance and also voltage. For our purposes you should mostly switch the settings to DC voltage (each multimeter comes with simple instructions too).

That is what we will use for testing batteries.

You can see the dial in the middle, all you do is turn it to the right settings to make your measurements.

With a multimeter you can test the battery voltage and even the resistance. Remember that these measurements should be done when the battery is not connected to any device or load.

Let's have a look at what useful information you can get with your multimeter and some tips for using it correctly

- First, set the dial to the proper setting, whether AC volts, DC volts, resistance, DC amps (current) and AC amps.
- Next, there is often a range of measurements you can choose from microtesting (like small electronics) to household current (much higher power). If your meter runs off the dial when you put it on the battery then simply up the range you are using to the next level then you will be able to read it.
- Just like we learned in High School Electricity class, Red is positive

and Black is Negative. Make sure when you are using the probes that you only touch the positive lead to the positive pole of the battery, and conversely the negative (black) lead to the negative pole of the battery

- When testing resistance, measured in ohms (Ω they use this symbol on the meter usually), touch the probes positive and negative together, this will put the device to zero, and allow you to measure resistance easily.
- The probe tips should always be kept clean to ensure accurate measurements.
- Do not touch the metal tip of the probe when you are measuring, and always put only the tip, not the side, to the battery pole.

Examples Using Your Multimeter to measure voltage and resistance

In the next few photos we are showing you examples using the multimeter measuring both resistance and voltage on these rechargeable batteries, and we will explain what the readings mean as well.

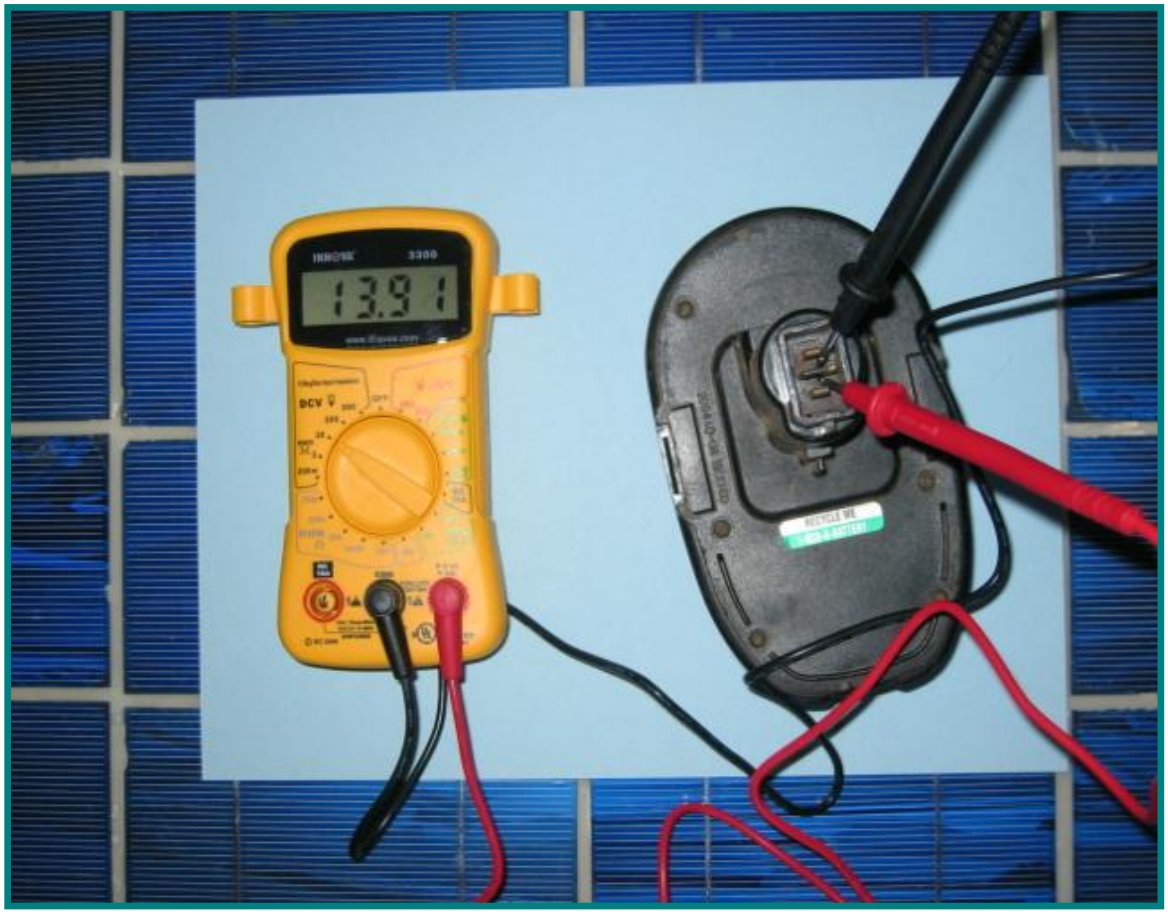
Remember to measure the batteries when they are not under load. ie. When they are not connected to any device. You will need to disconnect any device that they are used to run, phone, cordless drill, or whatever it may be. Simply take out the battery to do the measurement so it is

accurate.

The first picture here is of our Dewalt Drill pack. It should show a voltage of 14 volts, as it did when it was new, but as you can see it does not.

This battery pack is one that we are going to show you later that we replaced, and show you sources of new parts to fix and recondition it.

Here is a picture of a good rechargeable drill battery, showing nearly 14 volts (it is not completely charged as we were using it just before the photo)



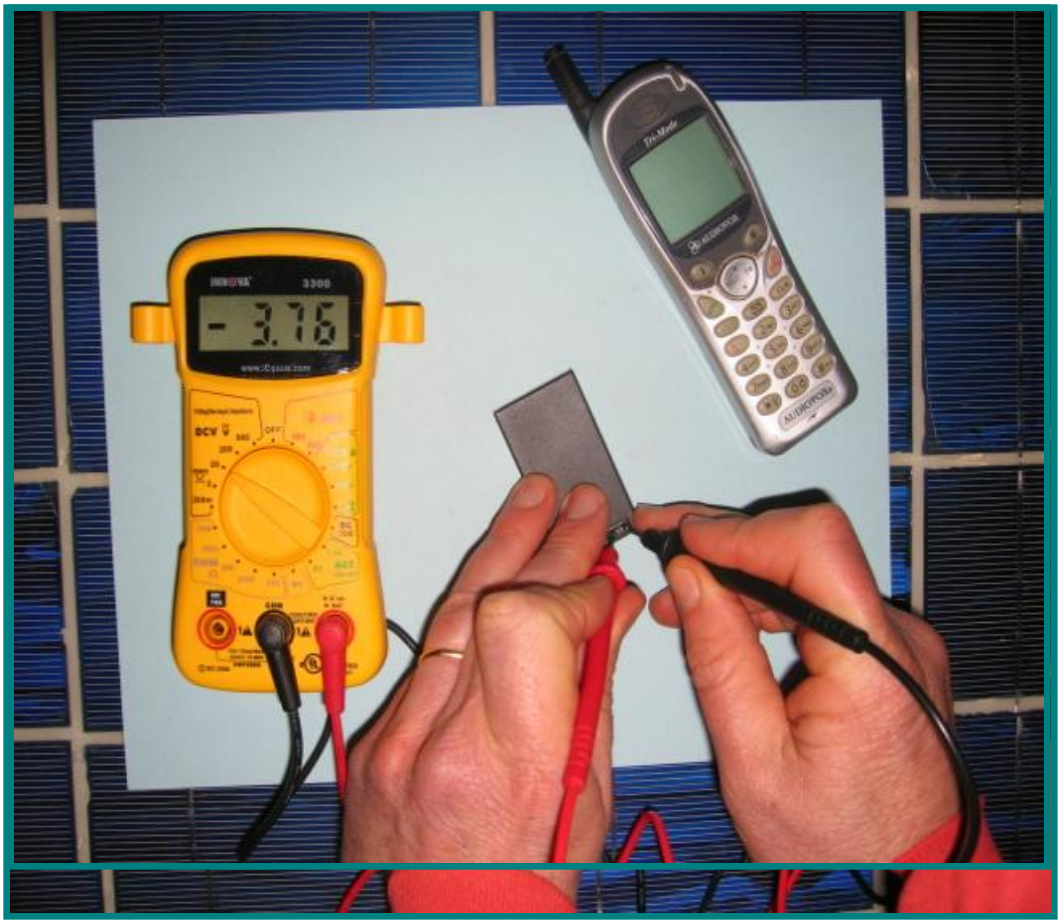
You will note that the voltage reads positive. If you see a voltage with a – (minus) sign ahead of it, you have the red and black leads in the wrong places, switch them for proper voltage readings.

It is important to note that some battery packs do not show which is the positive and negative terminals, you have to determine this for yourself with the multimeter.

This next picture shows a small AA NIMH battery that I use in my pocket flashlight. It should show a voltage of 1.2 volts, but as you can see it actually reads a bit more. A good battery that holds a charge will do this at

times.

This next picture shows the same battery discharged to under 1 volt.



The next picture is of our cell phone battery, a lithium battery, you can't see it very well because it is so small, it should read 3.6 volts.

You can see by the (-) sign that I have the positive and negative leads in the wrong place as there is no indicator to tell you which pole is which. It will read the same voltage though.

Onto resistance, this is the dead battery, showing less than 0 resistance.

Now we will help you with this table to interpret exactly what this all means. Table 1 shows the interpretation of the voltage measurements, and Table 2 shows Interpretation of the resistance.

Table 1. Voltage Readings

Voltage Reading	How Do we Interpret the readings
110 to 120 % of stated voltage. This is normal.	It should be expected for nominal voltage of a good battery
less than nominal voltage.ie. Should be 12 volts, but reads 9	This battery is not taking a full charge. If it is a NiCd or NiMH, try reconditioning it.
Showing zero volts	This battery is very near dead. It cannot be reconditioned. Try rejuvenating it, to see if it can be brought back to life.

Table 2. Resistance Readings

Ohms reading	How Do we interpret the readings
Infinite ohms, shows (OL or overload)	This battery is dead or there is an open connection somewhere. If you cannot find an open connection, try rejuvenation process.
Zero Ohms, or negative	This battery has an internal short, or there is a short in the wiring. If you cannot find a short in the wiring, try the rejuvenation process.
Reading between 0 and infinity	This is normal. If you make regular readings on a battery, the resistance will probably slowly increase over time.

By comparing our measured results on the previous pictures with the tables you can quickly deduce that the cordless drill battery is pretty dead and in need of rejuvenating, while the other batteries tested (cell phone,

good drill battery and NIMH) are just fine.

Testing Your Batteries with a Battery Tester

Using a battery tester provides much different information than that of a simple multimeter.

Before we begin let's have a look at a simple price comparison of some different models.

Battery Tester, about $5

Battery tester, about $12

Battery Tester, about $60

Battery Tester, about $130

As you can see the prices vary widely. We have put together a selection from our favorite shopping network for you to take a closer look, visit the site and check out all of the different models.

Find a Battery Tester (click here)

Unlike a multimeter which can take several different measurements all with the turn of a dial, a battery tester can only measure the useful charge that remains in the battery.

Mainly our family uses a small battery tester to test AA and AAA rechargeable batteries, it cost less than $10 and saves us a lot of time telling us when a battery is no longer useful. We then recycle it at our local depot.

We do have a larger battery tester that we use for our car and deep cycle batteries, it works the same way, telling us when a battery is past being useful. This type of battery tester simply measures the voltage while applying a small load.

On your cell phone or laptop (which runs on a battery backup) there is a small icon on the screen that tells you the remaining charge of the battery. This is a small automatic battery tester built into the machine, and they usually work pretty good.

Most battery testers are battery specific, only measuring certain batteries for their charging ability, AA and AAA or larger ones, make sure you get the right one for your applications, check out the link above to find the right one for you.

Battery testers have built in resistors that only let a certain amount of current through the circuit, allowing you to only test certain batteries.

Using a battery tester is really quite simple. Some use a simple needle gauge, while some use digital technology to tell you if a battery is good or not. Just follow the directions for each type of battery, that is provided in the package. Read the instructions before use.

You can see by the previous pictures basically how they work. You need to put the + and – ends in the respective slots or clips and then it will tell you the condition of that particular battery. Some tell you a number for the voltage, others say a % of useful charging ability, either way it is up to you to interpret the information correctly.

The normal procedure we use, is to charge the battery fully using the appropriate charging device for that battery, and then put it on the battery tester. The tester will give you a reading of the useful charge in % or voltage, then you can easily determine if it is good or not, or whether you should begin reconditioning that battery. A simple but effective method.

Testing Your Batteries with a Battery Analyzer

For the past few years we have been using a battery analyzer to more fully understand our battery charging cycles in order to make our batteries last longer. The one we chose was the one pictured above the CBA II

Computerized Battery Analyzer. It works great and provides a wealth of information.

It cost a bit more than either a battery tester, or a multimeter but it gives us a lot more information too. The battery analyzer looks at the compete cycle of the battery from charged to discharged and gives you a graph (on the computer) telling you everything about that particular battery.

Its capacity to hold a charge is measured and graphed.

It is measured in amp hours, or current times hours, this is a useful guideline in determining how long your battery will hold a charge.

The device is only used with rechargeable batteries, as disposable batteries have only one life cycle.

Check out the one that we use.

Battery Analyzers (where to find one)

Whether you are going to just test your own batteries or use this device in starting your own battery reconditioning business the CBA II will give you everything you need, without having to spend thousands of dollars like some companies charge.

It came with a very good set of instructions and it was easily hooked upto the computer to read the data, something we were looking for. In order to show customers about their batteries, you can even print the information very easily on your computer.

Using your Battery Analyzer

The battery analyzer is hooked up to your computer using a simple USB

cable, just like downloading pictures from your camera, a very simple procedure.

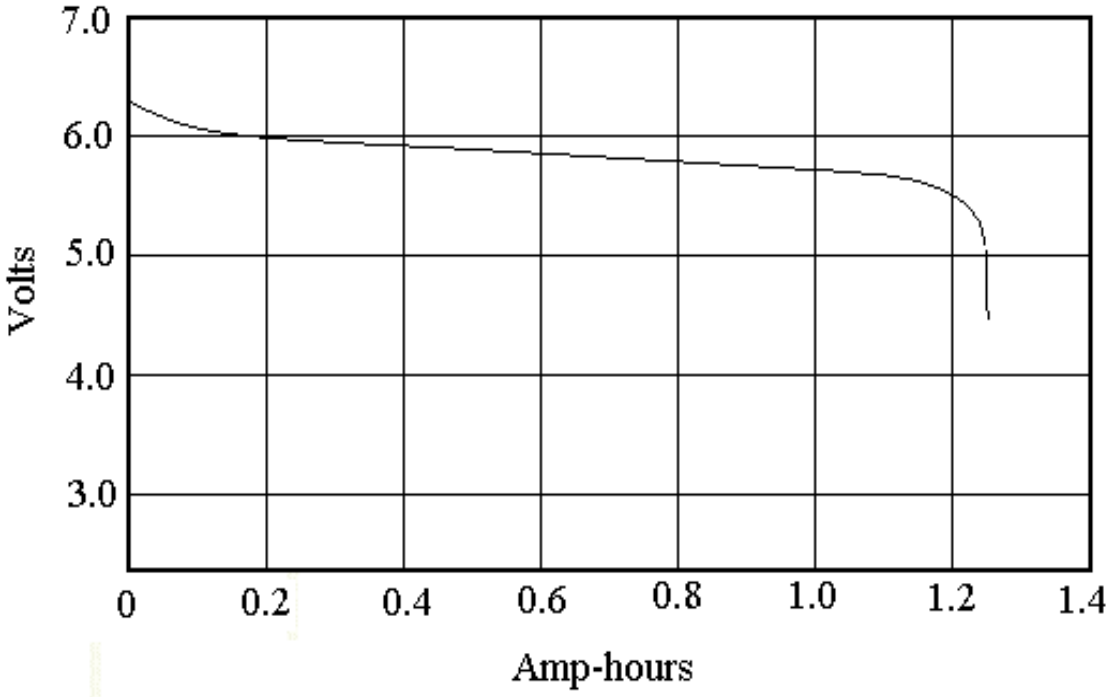
Just follow the simple procedure below to get the best results

- make sure the battery you are testing is fully charged
- connect the battery to the CBA II Computerized Battery Analyzer
- Use the alligator clips provided making sure the + and – are hooked to the proper posts of the battery analyzer
- next, connect the leads to the battery making sure the + and – are in the right place
- The CBA II software should be loaded onto your computer first, and this way you can assign a number or name to your test.
- Select which type of battery you are testing, Nicad, NiMH, etc
- Select the proper voltage and enter this into the software
- Enter the number of cells, if you cannot determine the number of cells simpy divide the nominal voltage of the pack by the nominal voltage of each cell

- Leave the Test Cutoff Voltage and Test Amps at default for the test.
- The battery analyzer will then discharge the battery, and give you relevant results.

The results will be shown in a graph just like the one below. This is a graph for a 6 volt battery pack that we used for this test. As you can see by the graph the battery has a capacity of just over 1.2 amphours.

See the graph below for details of this example test.



This test showed the battery operating at over 94% capacity, so it did not need reconditioning. Since it was a relatively new battery that is good.

If the measured capacity was less than ideal, we use about 70% of capacity as our divider, then we put it through the reconditioning process.

How to Recondition Your Rechargeable Batteries

Reconditioning rechargeable batteries is a simple matter of taking it through a very deep discharge cycle and then fully charging it again. Drain it down completely then top it up.

If this does not work then try our suggestions in the next section, rejuvenating the battery until you see results.

Of course, not all batteries can be renewed, some will have to be thrown out, try and send them to the recycle depot in your area.

Of course this is a very simplified approach to reconditioning your rechargeable batteries, but it does work most of the time. Let's now discuss our 2 other recommended approaches that you can use, first starting with the battery analyzer, CBA II that we discussed earlier.

Using the CBA II to Recondition Batteries

Follow these steps when using the Battery Analyzer to recondition batteries.

- Bring the voltage down to 90% of its capacity, but discharging the battery. If it is 6 volts (as the example above) then take it down to 1 volt to begin this process.
- Enter all of the relevant information in the CBA II program just like you did above, except for Test Cutoff Voltage and Test Voltage.

- Set the Test Cutoff Voltage to 1/3 of the nominal voltage of the battery pack ie. If your pack has 6 volts like the example above the test cutoff voltage should be set at 6/3 = 2 volts
- Set the Test Amps to between 1/10 and 1/20 of the rated current or amp hours ie. For the above example it would be set at between .06 and .12 amps for the reconditioning process.
- Click the start button on the screen to begin

- Again you will get a graph of output, charting amphours against voltage.
- The graph is not really of use to you, but the battery should show marked improvements.
- Recharge the battery and test its capacity again, it should be better. You can put it through this process upto 3 times as each subsequent reconditioning will improve the battery somewhat.

Without a Battery Analyzer, how do you Recondition Rechargeables

When we first started out, we could not afford a battery analyzer, what did we do then? Basically it is the same process, but you have to do it by hand. For this process you can use your multimeter to determine the voltage and amps.

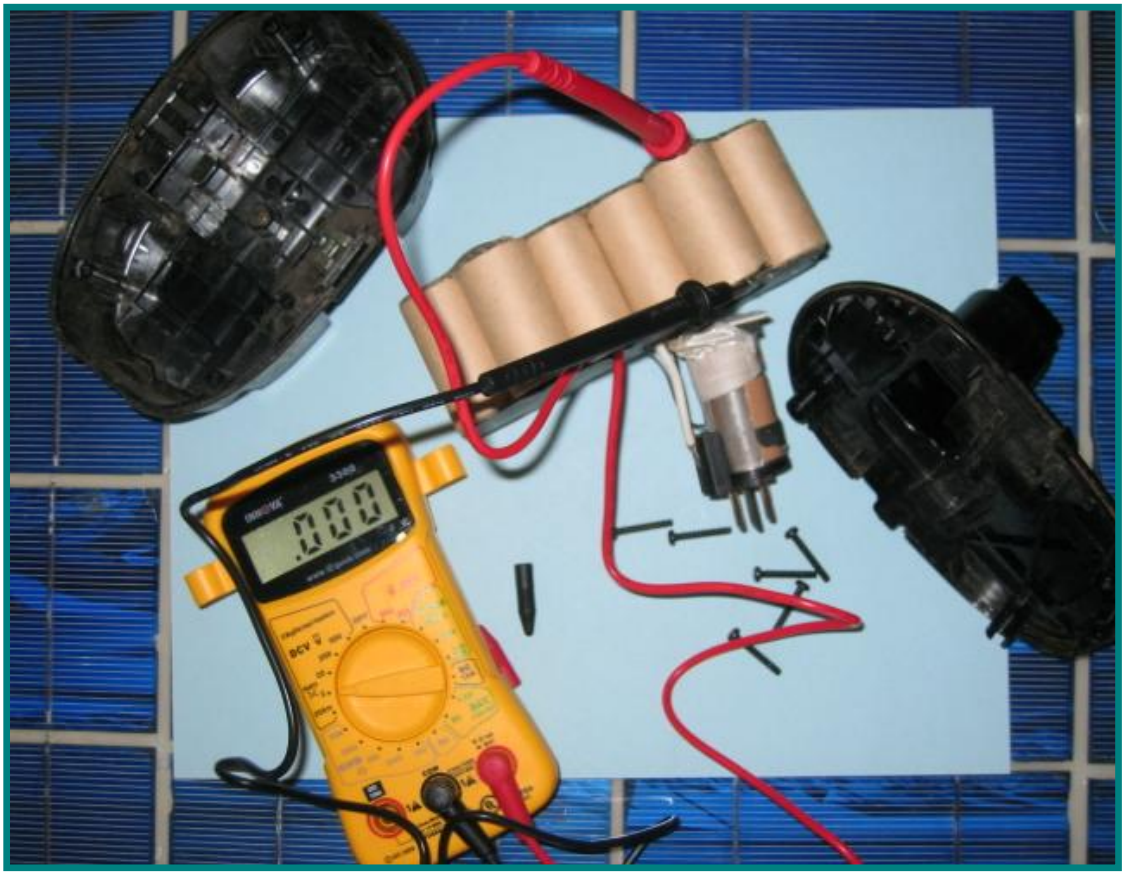
- As before, first discharge the battery to about 90% of its capacity.
- Just use the device (ie. cordless drill) until you get it to this level
- Use this formula to determine the current used for reconditioning, Reconditioning Current = Battery rated amp hours/10
- You can find the amp hours printed on the battery ie. If the amp hours is 11.2 then your reconditioning current would be 11.2/10 = 1.12 amps
- the next part is a little more difficult, you need to calculate the resistance needed to recondition the batteries. Remember earlier when we talked about battery chargers and we told you the devices all had a resistor in them so they are set at the correct levels for that battery, this is much the same.
- Use this formula, Resistance = Battery voltage/ reconditioning current, we will use the above example. We started with a 6 volt battery, this was taken down to 90% which is 5.4 volts. Next, we have a reconditioning current of 1.12. Simply plug those numbers into the formula, Resistance = 5.4/1.12 = 4.82 ohms. Now , find a resistor of at least 4.82 ohms and use that, nothing smaller or it will not work.

- Calculate what power level or wattage to use is next. Power or Watts = Volts x Amps , using this equation we have 5.4 x 1.12 = 6.05, thus your resistor must be able to handle 6.05 watts of power.
- Next, calculate the cutoff voltage (I hope you are starting to see why the CBA II Battery Analyzer was so great) , in our example of the 6 volt battery unit the cutoff voltage is simply 3 volts or half.
- We found a 5 ohm 10 watt resistor to use with this reconditioning process.
- Connect your alligator clip lead to each end of the resistor. Next connect the other ends of the leads to the + and – terminals of the battery. It does not matter which lead goes to which, as long as the circuit is connected in series with current flowing through the resistor.
- Finally, connect your multimeter to the battery as well, to monitor the process. After about 3 to 4 hours your battery will be reconditioned (usually). Do not let the battery voltage to fall below 1/3 of its nominal capacity, ie. In this example that would be 2 volts, or you will wreck the battery.

Just like before you can do this process 3 times, but remember that you are using up precious charging cycles each time you do.

The battery can only go through a certain number of cycles. Try and balance the benefits of reconditioning with using up these limited cycles.

How to Rejuvenate Your Rechargeable Batteries

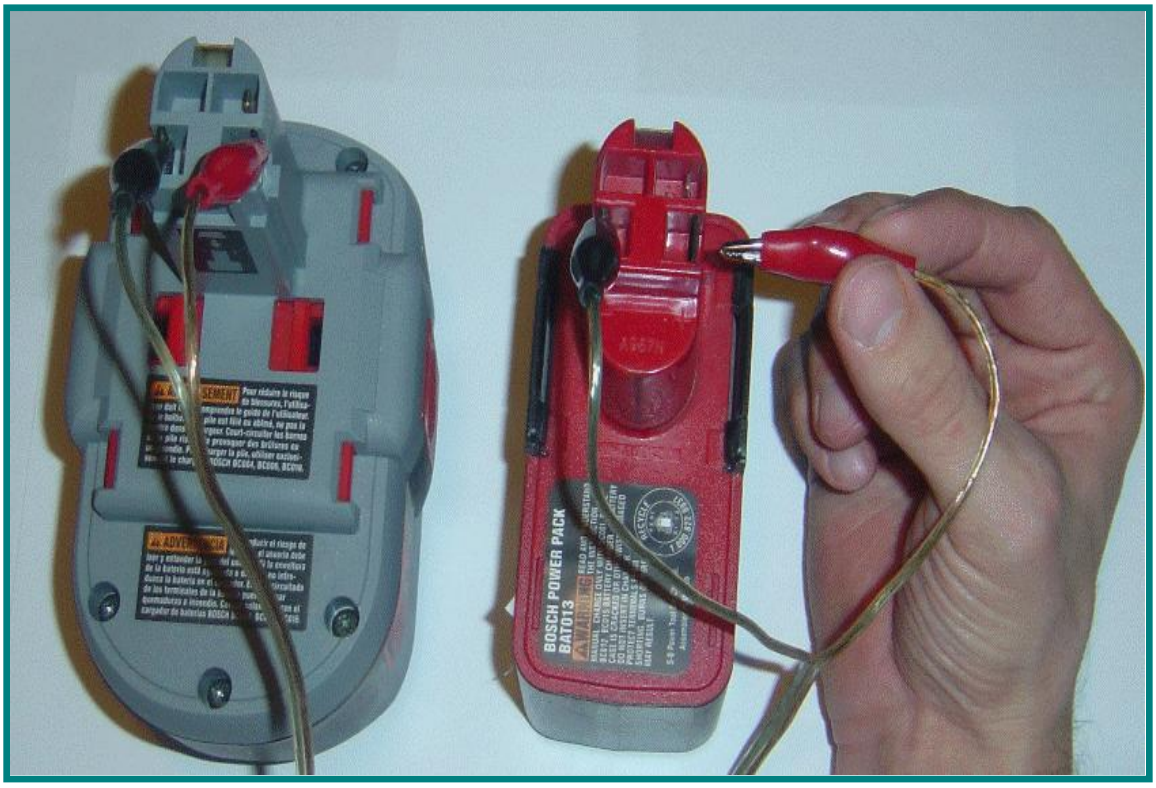


Rejuvenating a battery is somewhat different than reconditioning it. Basically the process involves applying a higher than normal voltage to the battery terminals for a limited time.

Here is how the process works.

- Start off with a similar good battery just like the one you want to rejuvenate. Remember that you are going to need higher voltage than what your bad battery has. ie. If your bad battery (the one in need of rejuvenating) is 6 volts you need a similar battery of about 12 volts.

- Wear your protective gear for this process, just like in all of the other processes.
- Connect the positive and negative alligator clips to the proper ends of the battery to be rejuvenated, make sure positive goes to positive and negative to negative



- this picture shows exactly what we mean, just tap the last clip on the battery being rejuvenated.
- Now, check the voltage of this battery, if it is where it should be you can stop, if not, you can tap the other pole (if you started with positive, then tap the negative one
- If nothing happens then the battery cannot be rejuvenated

- If you were successful then you will need to recharge the battery in order to be able to use it.
- You may need to recondition the battery as well, as shown in the previous section.
- Battery packs, as shown in the picture above are a bit different, you can actually test each individual cell, rejuvenate the ones as needed (or replace the cell that is defective) and reassemble it as shown above.

What Do You Do About a Reversed Cell?

This usually happens with a battery pack only. Inside you find several individual cells that make up the proper voltage for the pack. ie. 6, two volt cells for a 12 volt cordless drill battery pack.

You will notice that your battery pack does not last as long after being charged as it once does, this is the first sign that you might have a reversed cell in the pack

What happens when one of these cells weakens and causes the entire pack to reverse its polarity? What can you do?

There are a few warning signs before this happens. Usually the battery pack is discharged to a very extreme state. If one cell is discharged more than the others it begins to filter a charge away from the other cells in the pack. This flow of electricity is in the opposite direction as well causing the reversing of charge from negative to positive.

The solution to the problem is really quite simple.

Take apart the battery pack. There are tiny screws that hold it together. Check the voltage of the individual cells. Make sure to connect the positive (+) lead of your multimeter to the positive post of the battery, and

the negative(-) lead of the multimeter to the negative post.

If the multimeter shows a negative voltage then the cell has a reversed polarity, basically it is backwards now and is draining the battery pack.

To change the reversed cell back to how it should be you need to apply a high voltage shock. For the 2 volt cells in the example above, try sending a quick jolt of 6 volts through it. Make sure the postive and negative leads are correct for each battery before applying the shock.

This will almost always snap the battery polarity back to the way it was. But occasionally it doesn't, so you need to apply a slightly higher voltage of say 12 volts.

If you can't get it to come back, then the offending cell must be replaced for your battery pack to work.

Simply put the battery pack back together when you are finished. Watch the pack does not get discharged so low in the future or this one cell could reverse itself again.

How to Recondition Your Car Batteries (Lead Acid batteries)

Lead acid batteries are used in almost all of our familiar modern conveniences, from cars to boats to RV's and Golf carts they are used extensively.

No doubt you are very familiar with this type of battery.

Have you ever bought a new battery and traded in the old one? Did you wonder where the old one went? That's right, someone will pick it up from the mechanic (or wherever you purchased the new one from) and try and renew it. Some companies even pay someone to take them away.

It's no wonder, as most of these batteries still have a considerable useful life if you know how to recondition them.

Before we start with the reconditioning process, let's cover some background of lead acid batteries, and then introduce you to proper care and reconditioning.

Lead Acid Battery Background

Your Safety if First !

Lead acid batteries contain both lead and acid within the case, and this can be quite dangerous, so please follow these suggestions. The weak sulfuric acid can burn you quite badly. It can burn your clothes, your eyes or other valuable parts of your person (from experience, ouch).

Simple rubber gloves, a plastic apron and eye wear is a must. Don't get those cheapy eye goggles either, you will regret it. Buy ones that are almost like ski goggles that protect the top and sides of your eye too.

It may not be obvious but you should not smoke or have any flame around batteries either. There is sometimes slightly compressed gas in the battery which can explode if you are not careful.

Negative first... this is the rule when connecting or disconnecting battery cables. Red is positive, black is negative, and negative first, always... simple rules that will keep you safe.

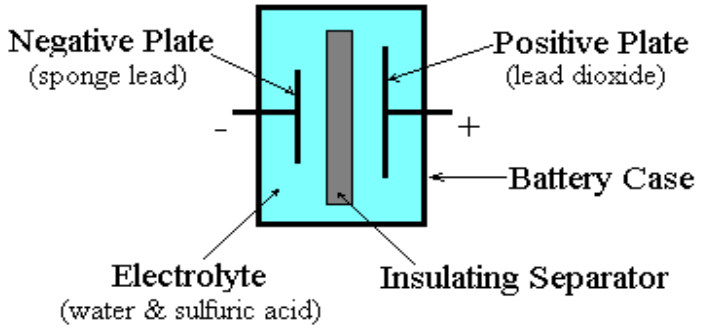
The Environment and You

Today it is more important than ever that we treat the environment in which we live with respect. There are materials in batteries that are considered toxic waste ie. Lead in the batteries, and must be disposed of properly if you need to get rid of any batteries.

It is important that you follow all local, state and federal laws regarding disposing of batteries that you can not recondition or rejuvenate.

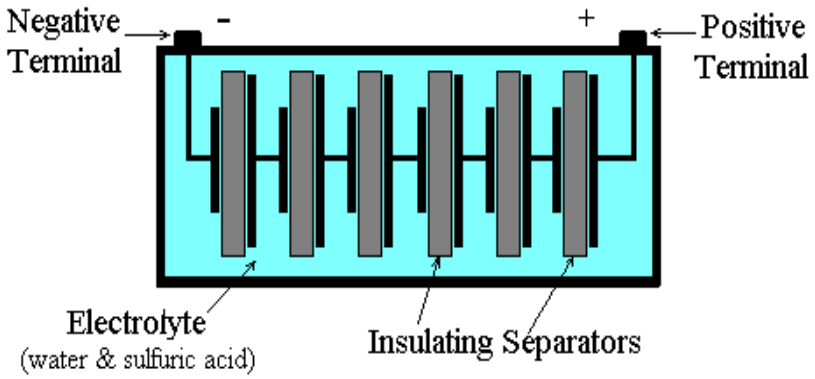
What do Lead Acid Batteries look like Inside?

It is possible to begin reconditioning lead acid batteries without knowing what they look like on the inside, but it is much easier if you understand what is going on in there before you begin. Here is a simple and quick look inside to help you understand the reconditioning process better.



As you can see from the above diagram a battery is made up of 2 plates, one positive and one negative, both of which are insulated from each other. Inside the case is a mixture of water and acid that the plates are submerged in.
A battery is charged by sending current through it backwards. After charging it is then able to run whatever electrical device it is designed to power.

Most batteries contain several plates separated by insulators, as the diagram outlines below of this 12 volt car battery.



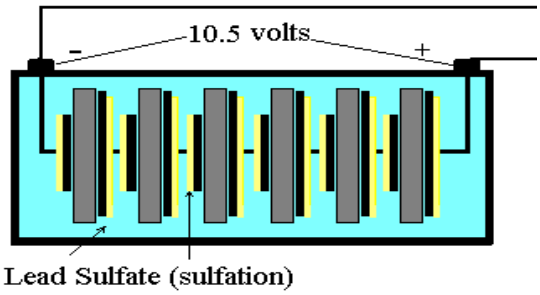
What is Battery Sulfation?

Some people use the term desulfation to describe the reconditioning of lead acid batteries. This is because the process of sulfation which naturally occurs within your batteries has to be reversed for the battery to be reconditioned.

What is sulfation and how does it occur?

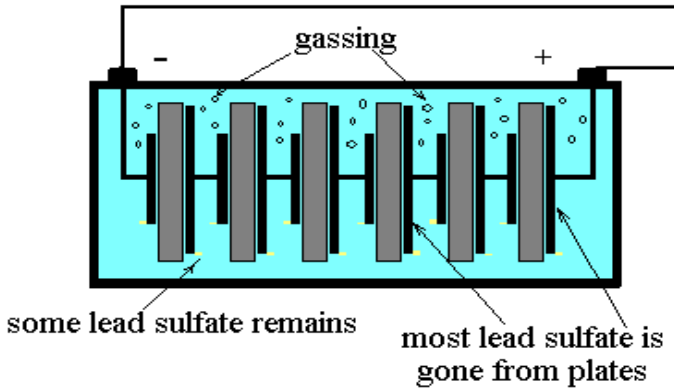
The sulfating process occurs as follows. As your battery is being discharged when you are using it to power stuff in your car for example, the positive plate (which is made of lead dioxide) reacts with the sulfuric acid in the battery to form lead sulfate. This is a solid that forms on the plate. The same process occurs with the negative plate as well.

This lead sulfate starts to build up over time on the plates as shown in this diagram (the yellow buildup on the plates)



After a few years of building up sulfates on the plates the battery no longer works properly and it needs to have the sulfate removed. This process is known as desulfation, and the equipment used to do this is called a desulfator. But for most of our purposes we use the interchangeable term reconditioning to describe this process for all batteries.

Normally, during the recharging process the battery sulfate is removed, as shown in the diagram below. The sulfate and water is turned back into lead, lead dioxide and sulfate in the liquid form. This is the normal charging process.



Usually if the battery is not discharged too far the sulfate will return to a liquid form during the charging process and not cause any problems at all. Those gas bubbles rising in the diagram are oxygen and hydrogen

gas, which is quite explosive (remember we told you not to smoke, or put batteries near open flame, this is why).

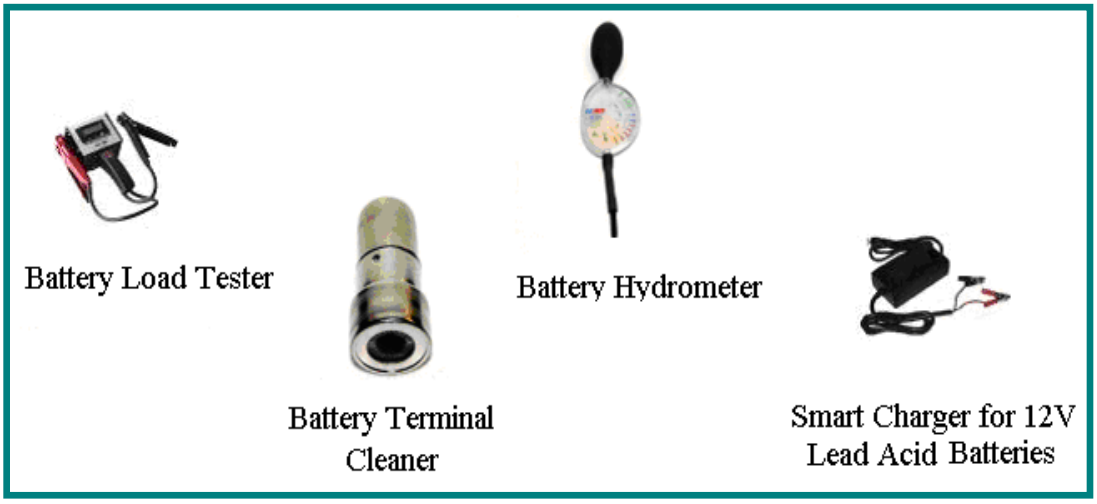
But if the battery is really low, or left in a discharged state the newly formed soft lead sulfate will harden onto the plates and you will not be able to turn it back into a liquid solution through recharging.

This is the process known as sulfation and it can eventually ruin your lead acid batteries. Eventually you will not be able to charge it at all because of this process.

Thankfully, using the process of desulfation (or reconditioning) we are going to show you how to bring most of these batteries back to life.

Next, we are going to cover what equipment you are going to need for the reconditioning process

Equipment You Will Need for working on Lead Acid Batteries



In order to work properly on lead acid batteries you will need a minimum of equipment. You should already have a multimeter, so we are going to deal with the other equipment you will need.

At a minimum you will need to find a battery terminal cleaner, hydrometer, load tester and a smart charger.

If you have a Battery Analyzer such as the CBA II that we mentioned earlier, you can use it to recondition lead acid batteries as well, making it a very good investment.

Home Testing of your Lead Acid Batteries

In our own reconditioning experiments we have found that only about 80% of all discarded batteries can be reconditioned. In order to find out quickly which ones can, and which ones cannot be reconditioned we perform 3 tests.

First we do load testing, then voltage testing and finally we test with a hydrometer (which we will explain how to use).

Before you begin testing, you need to let the battery sit for at least 12 hours or let it draw a small current for a couple minutes first. This removes any residual surface charge so that you get accurate readings.

Battery Load Testing

This is done with a battery load tester as shown in the picture above. It works very similar to your multimeter in that it is connected to the battery posts with alligator clips, red to positive and black to negative.

When you first hook it up you will get a 'no load' reading, but when you press the start button (sometimes like a trigger) and hold it down the battery load tester will show you the voltage of the battery.

Example readings for 12 volt car battery.

Voltage	Interpretation
10 – 12 volts	Battery is good
6.4 – 10 volts	Battery is weak, should be recharged
Under 6.4 volts	Battery needs reconditioning

Voltage Testing with a Multimeter

You will next do a no load voltage test with your multimeter. Simply put the black probe to the negative post and the red one to the postive post. The voltage will tell you in simple terms the state of the battery.

The following table will better illustrate the point. A 12 volt car battery is used as an example

Charge Level	Voltage	Specific Gravity
100.00%	12.7	1.27
75.00%	12.4	1.23
50.00%	12.2	1.19
25.00%	12	1.16
Discharged	11.9	1.12

If the voltage is much below 12 volts it either has a bad cell or it cannot be reconditioned.

Hydrometer Testing (you will need a simple tool called a Hydrometer)

This test can be used to test individual cells in a battery pack. Remove the caps, and draw some of the liquid from that cell.

The table above includes specific gravity readings to interpret what you find.

How To Recondition Lead Acid Batteries

There are 2 basic ways that you can recondition lead acid (either deep cycle or car batteries) You can use special desulfating equipment, which you can either buy or make. We include the plans here. Or you can apply an equalizing charge.

Let's start with the simplest method and that is applying an equalizing charge.

- Make sure that the caps are on the cells and that there is enough liquid in the battery. Add distilled water throughout the process if necessary.
- Hook the battery up to a recharger and fully charge the battery
- Then increase the voltage by 5- 10%, that would be about to 14 volts with a 12 volt battery.
- Watch for overheating, don't let them get above 100 degrees F.
- There will be some gassing of the battery with bubble rising in the liquid. It usually only takes a few minutes with the voltage raised to do the trick.
- Now discharge the battery to 60% and then recharge it fully

- It should be back to near normal.

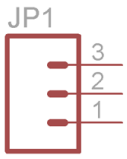
Method #2: Build A Desulfator

The second method to fix lead acid batteries is to desulfate them. The theory is that by using high amperage high frequency pulses you can dislodge all the sulfates from the plates of the battery.

A battery desulfator can be built for as little as $30 and about an hours worth of time.

First, let's have a little electronics refresher (on the following page)

Inductor



Screw Terminal

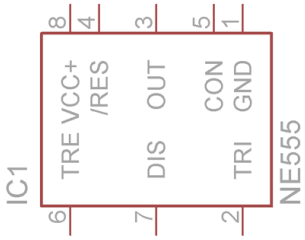
Resistor

Capacitor

The curved part of the symbol is the negative side of the capacitor

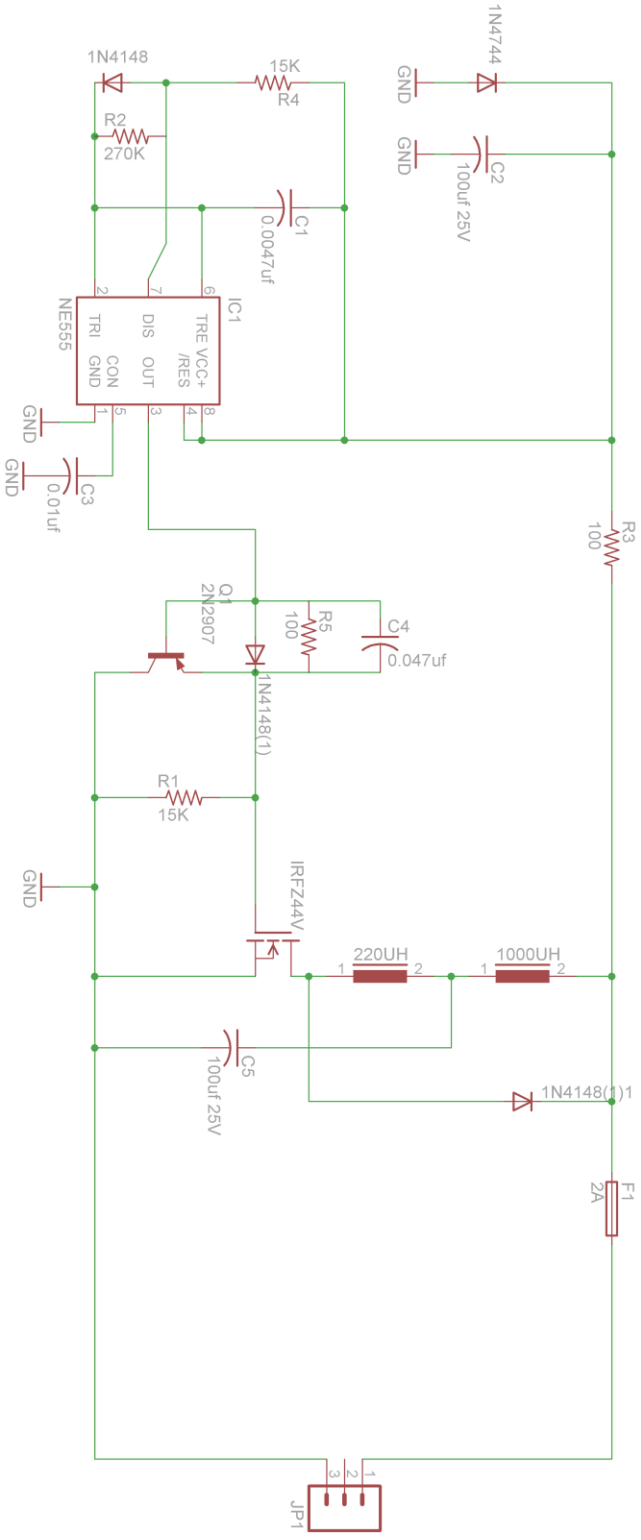
Diode

The line on the picture matches a line on the diode. Diodes must Be put in the corent way.



555 Timer Chip

The picture above shows you exactly what the parts are in the schematic below.



You can get all the parts from a website called digikey.com (they're really cheap).

Part #	Name	Quantity	Price
338-1721-ND	100uf Cap.	2	0.98
1N4744AFSCT-ND	1N4744	1	0.51
1N4148TACT-ND	1N4148	1	0.12
P15KBACT-ND	15K Resistor	2	0.08
P270KBACT-ND	270K Resistor	1	0.08
BC1110CT-ND	0.0047uf	1	0.08
BC2361-ND	0.01uf	1	0.25
P100CATB-ND	100 Ohm	2	0.02
BC1082CT-ND	0.047uf	1	0.09
497-2577-ND	2N2907	1	0.89
497-1963-5-ND	NE555	1	0.55
VF20120SG-E3/45GI-ND	FR602	1	1.50
2A Fuse	Hardware Store		
Wire	Hardware Store		
TE2154-ND	220uH	1	3.64
M8895-ND	1000uH	1	3.99

You have your pulser… now let's fix your batteries.

When you get the batteries you should check the fluid level. Remember to use safety goggles and rubber gloves. The fluid level shouldn't be all the way to the top, but it should be fairly close. It should usually be at the bottom of the plastic lip inside the hole. Distilled water is the best choice, but you can use any highly purified water. You don't want any chlorine and you don't want any minerals so don't use regular tap water.

For fork lift it's a good idea to use a small funnel. For smaller batteries such as car batteries you can use a bulb and tube (think turkey baster). Be careful though because you don't want to splash any battery acid on

you. The stuff will eat right through your clothes so don't wipe your hands on your pants.

Next, you should check the specific gravity of your battery with a hydrometer. You can pick them up for $5 at any auto parts store. You're aiming for about 1275 or more. Make sure you check each cell and write down the measurement before you start pulsing and charging.

Now you can hook the pulser up to the battery. Make sure the polarity is correct otherwise you're going to blow the pulser fuse.

Leave the pulser hooked up until the battery reads:

12 Volts- Charge to 13.8 volts
24 Volts- Charge to 27.6 volts
48 Volts- Charge to 55.2 volts

You're going to notice that after awhile your battery is going to hit a sticking point. By this I mean the specific gravity is going to stop rising. One thing to remember is to check the specific gravity of each cell each day so you can monitor progress. This is when an equalization charge is needed. Turn your charger up to high and charge to (3 hours max!):

12 Volts – Charge to between 14.4 and 15.6 volts
24 Volts- Charge to between 28.8 and 31.2 volts
48 Volts- Charge to between 57.6 and 62.4 volts

The reason we use an equalization charge is to mix up the solution of acid so we can continue with the reconditioning process.

After you're finished the equalization charge (2 – 3 hours) than hook the pulser back up and maintain your float charge. Monitor this for the next 2 weeks or so.

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First of all, the link that you will put on your web site will have the following format...

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You can link the Clickbank "hoplink" to text on your web site, a banner ad or other graphic, or you can use the hoplink in a classified ad or maybe even something like a Google Adwords ad or Overture ad .

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