# How effective is advanced battery charging on a battery and can it damage the battery?

I am asked all the time; do I really need advanced charging on my batteries ? What effect does a split charge diode have on charging ? What percentage of improvement will our products make on a system? Will the extra fast charging boil my battery? Will it excessively gas the battery? What effect in real terms can I expect? Most of the questions stem from old wives tales, rampant in this market. The idea behind this article, is to lay to rest all the old wives tales, and offer the facts. Remember, the below results are extreme and meant to show just how hard you can charge an open lead acid battery with no adverse effects.

## Part 1: The effect of voltage on battery charging

There is no magic with advanced charging systems. In effect all they do, is increase the differential voltage between where the battery is and the charge voltage; in other words, the higher the voltage that is applied to a battery, the faster it will charge. However, the down side is, that if you do not control that higher voltage after the charge is completed, you will over charge and damage your batteries. This simple experiment will show you the direct relationship between actual voltage applied to a battery and the current ( amps ) being absorbed by it. This will give you an insight into how your system can be improved and where the problem may lie .

This information is 100% accurate and can be reproduced on any test bench at any time, it is not a sales gimmick from Sterling; but a help sheet to show the general public in simple graphic terms what effect the higher voltage attained by advanced charging has on batteries.

The test is very simple and not open to misinterpretation. We will use a simple lead acid, so called 'leisure battery', of about 100 amp hrs; a low cost, nothing fancy battery. All we have done is to discharge the battery to about 50% of its capacity, then connect it to a 180 amp regulated power supply. We will simply pick key voltages and log the current the battery can absorb at different voltages as it charges.

For example, the red line shows that when the battery was 50% full at 13.2 volts the charge current was 35 amps and at 14.8 volts the charge current was 160 amps. An improvement off about 457%. However the black line on the graph which was taken when the battery was about 70-75% full, shows that at 13.2 volts the current was about 1 amp ( showing that at 13.2 volts the battery was full, in its opinion); where as at 14.8 volts we were still putting in about 60 amps; a charge improvement of 6000%. (Rather an improvement to say the least ).

**Why the specific voltages ?**: The voltages chosen are real voltages which one would expect to see in real life.

**13.2 v**: this voltage appears in 2 main circumstances.

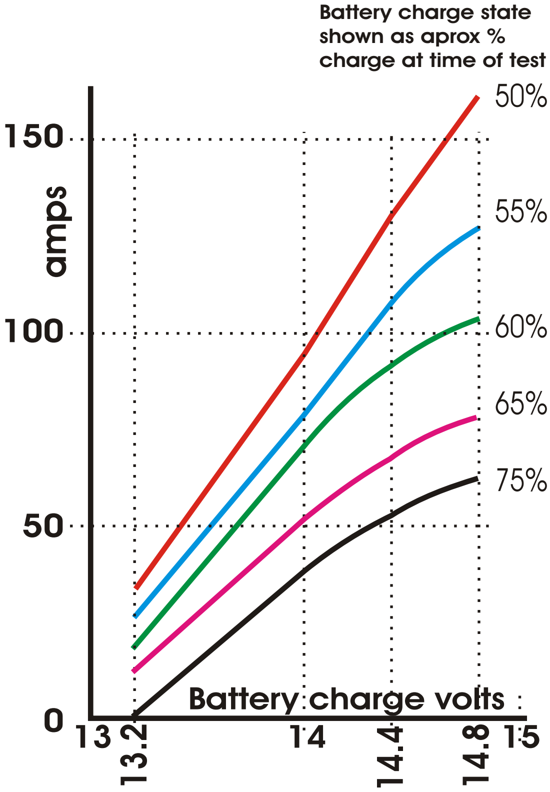
a) If you use a split charge diode then one would expect this sort of voltage at the battery.

b) Most alternators now have a built in temperature compensator on their regulator. When the engine room heats up ( especially on a vehicle ) then the assumption made by the alternator manufacturers is that the battery should be full. So as the warm air in the engine room is pulled past the regulator the voltage from the alternator is reduced; the end result is, that we have seen standard vehicle alternators start off at 14.8 volts and drop to 13.2 volts in vehicles ( with the bonnet down ) after about 20 minuets. This is o.k. for the starter battery but will ensure your secondary batteries never charges correctly ( as per the graph ).

**14 volts:** This is where most alternators start from; and is a standard expected alternator voltage from a alternator.

**14.4 volts:** This is the voltage used to charge sealed lead acid batteries to prevent gassing.

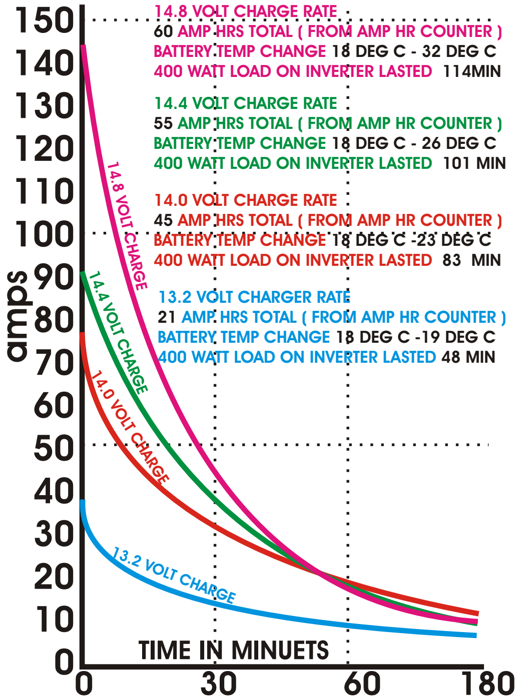
**14.8 volts:** This is the voltage one can push up to, in open lead acid batteries, without any damage to ancillary equipment, which will be connected to the battery at the same time. Apart from the obvious increase in charge rate this prevents sulphation of the batteries.




Having established the dramatic charge improvement which a battery can achieve with the increase in voltage, the many sceptics amongst us will now say, well o.k, the battery will charge faster, but you will gas the battery profusely. You will over heat it, and boil it; and all that extra current going into it will not being stored; but simply gassed off. Meaning in essence, that the apparent fast charge is a waste of time, and that all you have done is wreck the battery. All appear valid points, and are prolific rumours. Now lets see if they are true or simply old wives tales.

## Part 2: Will this fast charge rate cause problems.

With test 2, we take 4 x 100 amp identical lead acid batteries as per the above test. We connect all 4 together and discharge them to the same level. Then we charge one at a time ( using a 200 amp regulated power supply ) and over a 1.5 hr period and see how much charge in the form of amps are absorbed into the battery. Then using an amp hr counter we can measure the actual amp hrs which have passed into the battery. After the battery has completed its charge cycle at the allocated voltage , we see if the amps are actually in the battery as storage amps. We do this by discharging the battery through an inverter with a 400 watt light bulb load; timing how long each battery can run the load after it has completed its charge cycle. If the amp hr counter shows more amps going into the battery and the load runs for a longer period of time; then the amps must have been stored in the battery. We also measure the battery temperature before and after the charge run to see if the battery is in danger ( 50 deg c is when a battery starts to have problems )of over heating and boiling. The battery caps were removed from the battery cells to inspect the plates to ensure there was no excessive gassing, which there was not.




**Answers to the questions based on actual facts :**

1) Will the fast charge rate also put more into my batteries ? One can clearly see that on the 13.3 volt charge only 21 amp hrs were put into the battery as opposed to 60 amp hrs with the 14.8 charge. An improvement of about 300%.

2) Did this 300% improvement actually go into the battery or was it simply lost in heat and gas etc? The inverter discharge test clearly shows that the 13.2 volt battery ran the inverter for 48 minuets, where as the 14.8 volt test ran the inverter for 114 minuets, a clear 230% improvement. So yes, the extra amps were being stored in the battery, and were accessed by the inverter and used.

3) Will the high charge rate boil my batteries?. One can see the rise in the battery temperature at 14.8 volts was from 18 deg c to 32 deg c, which is still well below the manufacturers recommended temperature limit of 50 deg c. Also bear in mind that this test was charging a 100 amp hr battery at 150 amps, in real life with 4 x 100 amp hr batteries you would need a 500 amp alternator or battery charger to be able to reproduce this test run.

4) Is it possible to put a lot of power into a battery in 1 hr ?. The graph clearly shows that the bulk of the power absorbed by the charger was in the first hour. So obviously the battery was comfortable with this as the temperature rise was well within the battery's limits.

5) Does a 100 amp hr battery give 100 amps of useful power? Simply not true; even with the best charger, at least 40% or 40 amp hrs tends to be no use in a battery.

6) Are there any other benefits from this fast charging? Yes, you also de sulphate the batteries, dramatically increasing the life of them. You will also reduce the running hours of your engine and fuel costs, associated with the charging of the batteries. In fact there are no down sides to this process.

**Conclusion: Its quite clear that all the fears are old wives tales. Now all you have to do to harness this information is to add a computer program to store the charging curves, allowing the software to control the charge of your batteries, and then, hey presto, welcome to the world of advanced digital charging from Sterling power products.**

# What is the best battery to use for an auxiliary charging system ?

I keep getting asked this question all the time, when being asked which is the best battery? I refer to marine or vehicle auxiliary charging batteries or domestic batteries. To say there is a lot of confusing literature about this subject would be the understatement of the year. The information in the literature tends to be correct , but it's the bits which are not in the literature, and the customers' assumptions that cause the confusion and hence the problems. I will try to answer the question. But in order to save you time , I suggest you adopt the following attitude, and make the person trying to sell you these things answer the questions below.

The key question

Another way to approach this subject is the simple Irish way ( being Irish myself ). I went onto the web and obtained 3 different battery type prices, these were the first prices I came to, and have no reflection on any company. I was looking for about a 100 amp hr battery.

100 amp hr leisure.Normal open lead acid ( so called leisure ) £49.99
100 amp hr AGM = £ 175
100 amp hr Gel = £265.59

So in my simple mind the AGM. is about 3 times more expensive than the standard one. And the Gel, about 5 times more. So the question is; if these batteries are 3-5 times more expensive than the standard one, what do they do that is 3-5 times better. Do they last 3-5 times longer ? ( I think not, more like the reverse ) . Do they charge 3-5 times faster to reduce your engine running hours ? ( only in their dreams ) So rather than ask me weird questions; please ask the sales man, who is trying to sell this stuff for cycling, exactly what you are getting that is 3-5 times better than standard lead acid batteries . Then please let me know as I could do with a good laugh.

**The brutal truth about marine leisure batteries.**

1)There is no such thing as a marine battery. If you see a marine label on a battery it is simply words and may as well say Mickey Mouse.

2)For cost and performance open lead acid batteries are king. All other batteries are a derivative of this, with variations to suit different markets, where there are specific problems implementing the standard lead acid battery. E.g Gel, is a standard lead acid battery except that the acid has been transformed into gel. But by solidifying the electrolyte, you introduce many problems not associated with free flowing water based batteries.

3)"Most expensive is best " This is so not even close to being true. In fact I would say the reverse is true in the marine leisure market. When reading all the sales literature regarding Gel/A.G.M, please note that non of their curves and claims refer to standard lead acid batteries ( They know better ). They never claim they have better performance than standard open lead acid, this is just an assumption on your side. They claim weird things; including longer shelf life, and that you can turn them upside down and have your dinner under them. Who cares; I want fast charging, long life, plus good value for money from my batteries. I don't want to sit and watch them on a shelf for a year and have my dinner under one.

4)If a statement says that this is the best battery. The question is, best at what aspect?

5)If the term 'maintenance free', is on a battery, then treat this with caution. There is no such thing as maintenance free, all batteries are basically the same. A Gel, sealed lead acid, and AGM are all only maintenance free because of the reduced charging performance curves; and not because there is something special about the battery. If you charge a normal lead acid battery to the Gel or AGM curves, then they would not require maintenance either. Remember 'maintenance free' is a handicap to fast charging not an advantage. This feature, which on the surface looks good, is, in most cases the worst feature that you could possibly buy; as this feature dramatically limits the maximum charging characteristics of the battery.

6)Fast charging costs water. i.e. if you want to charge you batteries fast, don't touch a Sealed/Gel/AGM etc with a barge pole. Fast charging will result in a certain % water loss from the battery. If the battery is sealed the water loss cannot be replaced. REMEMBER FAST CHARGING AND SEALED/MAINTAINCE FREE ARE A CONTRADICTION OF TERMS. You may not like this , but tough, it's the way it is.

7)Watch the term leisure / deep cycle as it simply does not exist. The standard, so called, leisure batteries, are simply starter batteries with extra support for the active lead material. This may increase the life by 5-10 %, but does not turn a starter battery into a deep cycle battery. True traction ( deep cycle ) are not available at a sensible price and are uneconomical to use for standard leisure use. However, if you plan to live onboard or travel the world then do look at 6 v or 2 v traction and build your battery bank up from those batteries, but expect to pay about 3-6 times the price of so called standard leisure batteries. On a daily use cycle, the standard so called leisure battery ( which is a starter battery )will last you as little as 6-8 months where as traction would last 15 years. But on a leisure rating ( 2 weekends per month and about 4 weeks holiday) then you would get about 5-7 years out of a standard leisure. That's if you charge it right using advanced regulators, and constant current battery chargers )

8)Battery sales companies quote battery cycles such as 6000 cycles for the battery. This looks good on the surface, however it will be 6000 cycles at say 10% discharge. This is a meaningless figure. All batteries have a manufacturers' graph, which odds are, you will not see in full; as the embarrassing section tends to end up on the advertising companies editing floor. The graph will have % discharge on one side, and cycles on the other. This graph is sometimes shown on glossy battery information, but is normally censored at about 30-40% discharge, where the figures can still show 4000 cycles. What they fail to show is the 100% discharge cycle ( which they off course say you should never go to , and I am not for one moment suggesting you should). This, at the end of the day is the only ultimate datum point. Whichever battery performs the best at 100% discharge, will perform best at 50% etc . The interesting fact is, that they are all about the same, that is, because they are all basically the same battery. A Gel and conventional starter battery go down the same production line until one has a gel substance put in it and the other liquid. The shock with this figure is that for Gel, Sealed, or leisure, etc, the constant figure is about 30-60 cycles, where as true traction with thicker plates is over 300 +. ( however, don't expect to see this graph on glossy literature, as they are way too frightened of this graph and will not release it ). It is however available from correctly specked commercial batteries.

So which is the best battery for **standard domestic *leisure* use?**

The job I am referring to, is for auxiliary charging systems on boats , camper vans or vehicles. I am not getting into what each and every battery type is best at, or for; as each type has a market, it just maybe not this market.

To pick the best battery for your job, then at least understand how they work. Forget the actual chemical formula and all the fancy terms around. The bottom line is, that lead acid batteries have been around since the 1st World War and the basic principles have changed very little since. The only thing we all agree on is that they are not environmentally friendly, but are cheap to make, and will remain king until such time, as someone comes up with a solution which can compete. Which by the way to date they simply have not. How do I know this ? Well its very simple, if they had, the lead acid battery would be out the door so fast its toes would not touch the ground.

So how do they work?

Lets understand the basics. They are all lead acid , but fall into 2 basic groups. A starter battery and a traction battery (fork lift truck, true deep cycle ).

Type 1 ( starter batteries ). A battery is simply a bucket of energy. If you wish to get the energy out fast, to start a engine ( cold cranking rating ) then you need a large surface area ( large plate size ). The only way to get a large surface area into the bucket, is to make the plates thin, so they can squeeze into the bucket ( this is your starter battery; it needs the cold cranking kick in order to start the car, so its plates are thin to achieve this). This theory is pushed even further with batteries which increase this surface area more, to make what are known as high torque batteries. These deliver even higher cold cranking, by putting the plates in a 'swiss roll' configuration, in order to make them thinner and increase the surface area. This is good for cold cranking, but has a fatal flaw when it comes to fast charging. ( the problem is, it works too well when charging and destroys itself ).

Type 2 ( traction or fork lift truck batteries). These batteries are not interested in the cold cranking kick, which is required for a starter battery, but are still interested in the power in the bucket. So they can reduce their surface area of the plates. The good thing about being able to reduce the surface area, is that you can make the plates much thicker. The end result is you still get the same power from the bucket, it is simply delivered at a slower rate.

So, for deep cycle and long life, the traction batteries are by far and away the best. But their price tends to kill them. However, if you are doing a long journey around the world, or going away from the U.K for 2 years plus, then investing in 2 volt or 6 volt traction batteries is a must, regardless of the cost. They will pay for themselves many times over. For general leisure use they are the best, but a bit of a waste of money, unless you intend keeping the boat for 15 years to get the use out of them.

So what's the end result of these two battery types,

A battery is made up of lead plates, with a lead paste on the plates. Every time the battery is used, then so many bits per sq inch fall off the plates, if you have a large surface area then a large number of bits will fall off.. Then to make matters worse your paste is thin so you cannot afford to lose the paste. However, if you have a small surface area and thicker plates the same is true, but the plates are thicker and as such, you can afford to lose a small amount of paste. In a nutshell, that is it, or be it in very simplistic terms, those are the differences between traction batteries and starter batteries.

As you can see from the above 2 battery types, the plate configuration cannot be blended. If for starting, you have a large surface area of thin plates, for traction you have a small surface area of thicker plates. One is black and one is white, there is no grey area. So, if you are purchasing a battery and it has a cold cranking rating, and the salesman says it is a deep cycle battery, but will also start your engine; then it is in fact a starter battery ( end of story ).

What we want now is the best for general leisure :

Having understood the 2 basic types then you need to ask yourself what do you want from the battery.

**Most people want**

***1) to charge their batteries as fast as possible in order to reduce their engine hrs.***

***2)pay as little as possible for the above.***

***3) get about 5-7 years use as a leisure battery, ( 2 weekends per month and about 4 weeks holiday per year ).***

If you are using your boat for leisure only, then stick to low cost lead acid so called leisure. If you want to turn your boat upside down for 5 secs. then the Lead Acid range with sealed removable caps would be a good choice.

If you want to turn you boat upside down for an hour or two then a Sealed Lead Acid would be worth looking at. However don't expect to charge them as fast.

Having had my so called opinion published in a U.K. boating magazine ( boy, do Gel battery suppliers love me. I was taken off their Christmas card list ), a Dutch magazine ran with it and the response was very good. The U.K. magazine did not follow up the article, however the Dutch magazine called' ZEILEN' did. ( The editor is Ruud Kattenberg ). They took the article and not only published it, but ran with it a lot of questions to their readers on their web page. They received over 500 responses and were able to confirm all my findings and published the results. ( Not that I need any conformation as we do this for a living, but it's always nice to have an independent source for folk who doubt you ). Is this not what magazines are all about, trying to help the people who buy them, and have a bit of a dialogue going?

**Conclusion: The best battery to use for fast charging using advanced charging systems**

**a) For general leisure use: use low cost Lead Acid which can be topped up with water. So called leisure batteries**

**b) For long term cruising then use 6 volt traction**

**Avoid Gel / AGM for 3 reasons**

**1) very expensive.**

**2) their fast charger rate causes them to gas.**

**3) poor cycling numbers.**