Battery charge

A heavy-duty battery discharge meter.

In spite the growth in alternative deep cycle batteries - AGM (Absorbed Glass Mat), Gel and more recently lithium - the traditional lead-acid battery is still the main source of power for aerial work platforms and industrial cranes. The main reason for this is the positive combination of cost and performance - it still offers a measurably better battery life than a Gel or AGM battery (although these are improving) while being considerably cheaper and widely available. The down side of the wet lead acid battery is that it requires a great deal more care maintenance and can deteriorate very quickly if not looked after.

The lead-acid battery dates back more than 150 years to 1859 to be precise - when it was invented by French physicist Gaston Planté. Although the basic battery technology remains the same there have obviously been improvements in materials, design and manufacturing since then, but the essential chemistry has not changed much since.

The lead-acid battery's ability to supply high surge currents coupled with low cost has always made it ideal for use in starting engines. However in order to do this well, it needs a large number of thin plates for maximum surface area and maximum current output - not at all good for deep discharge applications such as powering equipment all day. Starter batteries are lighter in weight than deep cycle batteries of the same dimensions because the cell plates do not extend all the way to the bottom of the battery case, allowing any lead shed from the plates can collect under the cells without touching the plates which leads to cell failure.

Deep cycle batteries on the other hand use fewer thicker plates that deliver less peak current, but can withstand frequent deep but steady discharges and regular recharging. However because of the way they are made they do need looking after and can suffer if mistreated. A badly maintained battery can fail within a year, while well maintained battery packs have been known to last more than 10 years in a typical scissor lift application - although three to five years is more typical.

Many battery companies have spent a lot of time and effort trying to educate battery users of the importance of good maintenance - outlining what and what not to do and dispelling some of the 'old wives' tales'. Battery maintenance practices in the powered access business have improved significantly in the 10 years or so that we have been publishing our regular feature on the subject, but it still has some way to go. However many battery maintenance issues do not lie with rental companies but with end users who are often guilty of over or under charging, through the use of long extension leads or not checking the electrolyte level on a regular basis. And if they ever top-up the electrolyte level may use tap water or even water from a puddle. All can destroy a battery. The problem is they have no sense of ownership.

Testing the specific gravity with a hydrometer

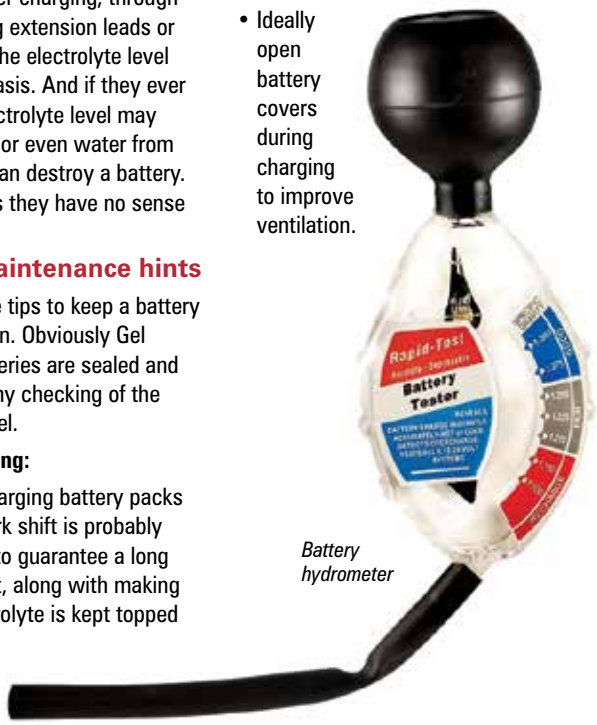
Battery maintenance hints

Here are some tips to keep a battery in top condition. Obviously Gel and AGM batteries are sealed and do not need any checking of the electrolyte level.

Proper charging:

Properly re-charging battery packs after each work shift is probably the best way to guarantee a long trouble free lift, along with making sure the electrolyte is kept topped up of course.

- Use as short a connection to the mains outlet as possible
- Before placing on charge ensure everything that draws power has been switched off
- Always charge in a well-ventilated area as batteries give off hydrogen gas as well as oxygen. Ensure there are no naked flames or sparks in the vicinity.
- Ideally open battery covers during charging to improve ventilation.



Battery hydrometer

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Battery electrolyte testing

Battery testing is an emotive topic within the access industry and there are various interpretations on how a wet lead-acid battery should be tested to ensure a prolonged life cycle or to establish if it is still useable. Incorrect testing may mean a good battery ends up in the scrap bin.

The hydrometer test is the best indication of battery condition - but is ineffective on flat batteries. For an accurate condition reading, the battery should be no more than 25 percent discharged - in other words fully charged. To do this first check the electrolyte level which should just be covering the top of the plates. Top up with de-ionised water if necessary and place the machine on charge for a full charge cycle. Operate the machine for a short period to even the cell voltages before testing.

To test, first clean the battery tops and remove. Place the flexible end of the hydrometer into the battery cell and gently squeeze the bulb, raising the electrolyte from the battery and up the hydrometer sleeve. This should cause the bubble within the hydrometer to rise. Release the pressure on the bubble and after a few seconds read the level of the electrolyte against the scale.

The difference between each cell should not be more than 0.005 or 50 gravity points as this would indicated a failing cell and reduce battery performance.

Testing the overall condition

The heavy-duty discharge test is carried out to establish the overall condition of the battery using one of the numerous heavy-duty battery discharge meters available on the market from around £25. Before carrying out the test the battery must have the correct electrolyte level, be fully charged with a specific gravity of 1.255 – 1.280 (see above) and check that there is no bulging/distortion of the battery walls.

Following the meter manufacturer's instructions attach the red/positive and black/negative leads from the tester to the battery, select the correct battery voltage and push the test button for the specified time (usually 10 seconds).

If the reading of 13.5 for a 12 volt battery and 6.1 for a six volt is maintained over 10 seconds the battery is in good condition. A slowly falling reading over 10 seconds indicates the battery is failing. A rapidly falling reading in less than 10 seconds suggests that the battery is beyond its service life and needs to be replaced.

Testing batteries not fully charged

The volt metre test can be used on batteries that are not fully charged. To do this test first disconnect the battery and use a test meter to check the individual battery voltage.

If all batteries in a four, six volt battery pack for example are equal but measure 5.20 volts or less then they are flat and require recharging. If one battery is lower than the others i.e. three batteries are 6.1 volts and one is 5.4 volts, then it suggests that the lower voltage battery is failing.

If the platform has been through its charge cycle it is best to operate it for a few minutes and then let it rest. This will allow the surface charge to dissipate otherwise a false high reading will be recorded.

Capacity	Specific Gravity	Volts
100 percent charged	1.255 - 1.280	5.95 - 6.10
50 percent charged	1.200 - 1.210	5.6
Discharged	1.140 - 1.165	5.2 - 5.3

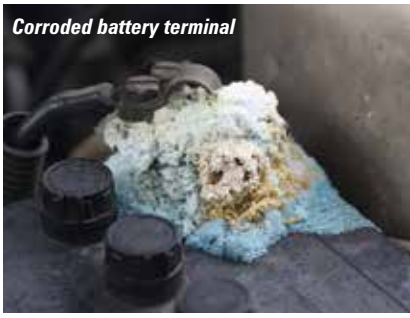
Make sure terminals are clean

Make sure of a good terminal connection

The battery terminal connection is critical for full battery pack performance. Often however this is overlooked leading to poor performance, arcing and corrosion. For optimum performance check that the correct size terminal is used and is securely crimped to the battery cable. Make sure the terminals are correctly tightened including the earth from the battery to chassis or motor controller. Check the Anderson power plugs for integrity and fit and make sure all terminals and connections are clean and free of corrosion. Terminals can be coated with a variety of proprietary substances or a petroleum-based gel - but use just enough to protect the terminal as it can also attract dirt and debris.

If the terminals are heavily corroded, hot water can be used to wash away the corrosion but any overspill has be disposed of under current waste regulations. Do not wash away the corrosion unless the cell caps are in place and you can control the spillage i.e. don't fill the platform's battery compartment with contaminated water as it is corrosive. A wire brush may also be used - again wear the correct safety/protection equipment.

It may be stating the obvious but always make sure that batteries are correctly fitted to the machine and all locating clamps are in place and tight.



Corroded battery terminal

A bulging positive is a sign of sulphation and the battery is useless

Top up with de-ionised water

Should I change the battery?

After going through the above tests and it would appear that one of the batteries has a failing cell and requires replacement you should consider several things including the age of the machine, whether the battery pack is original and whether one or more batteries have been changed previously.

With these in mind the question is do you replace the whole pack or just the failing battery?

If the battery pack is old opinion suggests you should change all of the batteries in the pack. After a short period of charge and discharge the new batteries will

be conditioned and give optimum performance. If maintained correctly they will have a longer life span. If the pack is made up of different batteries again change for a new matched set.

If on the other hand the battery pack is relatively new and uniform but has a failing battery, fitting one new battery will get the machine running and will of course be the cheaper option. However the new battery will never reach its optimum performance - it will be brought down to the levels of the other batteries in the pack which may lead to a shortened life for the new battery. Often when you change one battery it is not long before others in the pack need to be changed.

A classic battery pack

More than the price of a battery

Also consider that the battery price is only a small part of the cost, equally important is the labour to carry out the work and the downtime while the machine is not available for use or rent. This cost is magnified significantly if the battery pack has to be replaced in the field, and in this case you will need to add the intangible cost of upsetting a customer.

Choosing a replacement battery

When it is time to purchase a new set of batteries always consider the following basics first:

- Is the new battery the same Amp Hour rating?
- Are the dimensions the same - i.e. will it fit in the compartment and be held by the battery clamps?


US Batteries in a Skyjack mast lift

- Is the new battery the same weight as the battery originally supplied by the manufacturer? This is important for the overall stability of the machine as the batteries are part of the machines counterweight. Fitting lighter batteries may be a contributing factor to a machine tip-over.

It also makes sense to compare products and shop for the best value. However, as there are so many batteries available, it is very important to make sure any comparison is made with batteries of the same type, voltage output and capacity rating. This is where it can get confusing.

The information on the labels can sometimes be confusing as manufacturers do not always list the same testing criteria, making comparisons difficult. For example trying to compare two similar batteries that state different battery cycle life ratings because these are often based on selective data from the manufacturer.


A MEC 1332 scissor battery tray

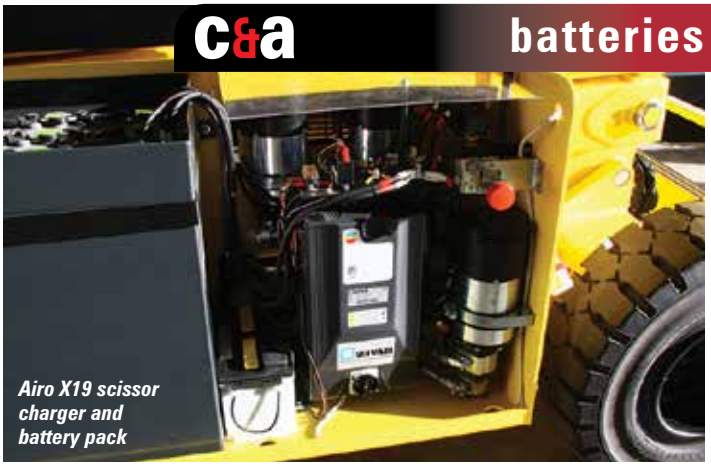
Comparing depth of discharge

Typically, cycle life ratings are determined on the Depth Of Discharge (DOD) and the percentage of amp hour (Ah) capacity discharged from the battery on each discharge. Most battery manufacturers recommend a 50 percent Depth Of Discharge for optimum cycle life, versus operating time. The problem is that cycle life can be quoted at a wide variety of Depth of Discharge ratings which can result showing a longer cycle life for one battery type over another making an inaccurate comparison. Therefore, when comparing cycle life ratings, make sure they are rated using the same DOD.

Amp hour ratings

Amp hour ratings are often used to compare similar lead-acid batteries but can also be misleading. For example, a six volt battery may list its Ah rating as 200 at the '20 hour rate'. This means that the battery will provide 10 amps of current for 20 hours, until the battery is fully discharged or 'spent'.

A common mistake however is assuming that a battery with a 200 Ah rating will provide 200 Ah at all discharge rates. This is where Peukert's Law comes into play which states that the greater the discharge rate, the lower the delivered capacity. So, if the same 200 Ah battery is fully discharged at 30 amps over five hours, it will deliver only about 150 Ah. Also, the relationship between battery capacity and the rate of discharge is not linear, so it is important to find the rated capacity at the discharge rate for the application where the battery is to be used. Most battery manufacturers publish tables of ratings versus discharge rate or discharge time for each battery type.



Airo X19 scissor charger and battery pack

Is the new battery the same weight as the original?

Operating time ratings

Even though manufacturers list various Ah ratings, it is often difficult to know which ones to use in order to make the right comparison for the application. It may be more accurate to use the operating time ratings in minutes that can typically be found on the battery manufacturer's specification sheets and websites. Comparing the rated operating time in minutes, provides a better idea of the performance that can be expected when comparing two similar batteries. These operating time ratings are based on the actual discharge currents seen in typical applications and may be more applicable than the Ah ratings.