Data-Gathering To Ensure Battery Warranties Are Honored

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Abstract

This paper will detail the data that should be gathered during routine battery maintenance (or via a permanent monitor) to minimize the chance of an argument with the battery manufacturer/distributor when the user attempts to claim a warranty replacement. In addition, guidance will be given on how to negotiate proper reasonable terms for warranties based on ohmic trending for Valve-Regulated Lead-Acid (VRLA) batteries since it doesn't always make economic sense to run a full-rate, full-time, load test for an inexpensive battery in order to obtain a warranty replacement. A load test may be in order for critical applications.

Standard Warranties

All battery manufacturers offer standard warranties that they will use and honor unless the user negotiates a differing warranty. These warranties typically offer full replacement (which may or may not include installation/removal labor and/or shipping, or just cover product costs) for a specific time period, and a pro-rata on the material cost for an extended time period.

In order to ensure that the warranty is honored, the user must make sure that they gather (at certain minimum intervals specified in the warranty) and keep specific data, such as temperature, float voltage, ohmic values, etc. The frequency of data gathering and the amount of data required to be gathered in these standard warranties are typically built around occupied locations with critical operations where battery maintenance will be fairly frequent (typically monthly or quarterly at a minimum), or if a permanent battery monitor is installed.

An example standard warranty is shown in Figures 1 and 2 (on the following pages) for VRLA batteries, with key data-gathering needs boxed in yellow, and manufacturer identification blacked out. As can be seen in the figures, there are some fairly stringent and frequent requirements for temperature gathering frequency to prove that the battery was not exposed to extreme high or low temperatures. Even more importantly, to have the warranty honored requires a full IEEE 1188 off-line performance test (which can require many hours offline in long duration backup applications).

Problems in Getting the Standard Warranty Honored

When the need arises for a warranty claim, one of the biggest problems is that many users (especially at sites without permanent monitoring) either don't keep adequate records to prove that they operated the battery within the temperature and voltage limits of the standard warranty, and/or don't do routine maintenance frequently enough. In addition, the manufacturer, per the terms of their standard warranty, may insist on a costly IEEE 450 or IEEE 1188 performance test that the user may not want to (or have the funds to) pay for. Thus, an argument ensues between the battery supplier and the end user, with the end result often being that while the battery supplier doesn't have to pay out for unprovable warranty claims, the user gets fed up with what they see (through their rose-colored glasses) as poor customer service, and thus decrease or cut off purchases from that particular vendor .

PRODUCT WARRANTY

LEAD ACID STATIONARY BATTERIES
VALVE REGULATED LEAD ACID FLOAT SERVICE

General Product Limited Warranty

warrants and valve regulated lead acid (VRLA) float service batteries and racks against defective materials and workmanship for the full period as defined in Table A from the date the battery is placed in service or the full period plus six months from the date of shipment, whichever occurs first.

A. If initial physical inspection identifies flaws in material or workmanship that would impair life of the battery, as defined by this warranty, or product performance, as defined by electrical and physical specifications as published at the time of shipment and these flaws are not due to transportation damage or installation abuse;

OR

B. If on initial "Acceptance Test", as defined in IEEE Std. 1188, "IEEE Recommended Practice for Maintenance, Testing, and Replacement of Valve Regulated Lead Acid (VRLA) Batteries for Stationary Applications", the properly installed battery string fails to meet the published performance ratings* per latest published catalog data at the time of shipment;

In the event of either A or B above, then contact your nearest sales representative to request instructions. You will be instructed either a) to return the equipment to an factory or service center location, FOB Destination-Freight Prepaid, for examination, or b) to wait until an representative arrives at the site to inspect the equipment.

If determines the battery or rack is physically or electrically unsound due to defective materials or workmanship on the part of , the defective cell(s) or rack component(s) will be repaired or replaced at the option of without charge to the purchaser (user) for replacement materials or repair labor. However, costs of replacement installation including but not limited to equipment, travel expenses of representatives(s), and costs of material transportation expenses shall be borne by the purchaser (user). The replacement battery shall only complete the remaining unused portion of the original warranty of the replaced battery.

** Published performance ratings. Initial capacity shall be a minimum of 90 percent of the rated string capacity upon shipment per IEEE-1188.*

Figure 1 – First Page of a Typical Standard VRLA Warranty

The battery is warranted to have a float service life from the date of shipment, as stated below, and based on conditions stipulated in the installation/maintenance instructions.

TABLE A – FLOAT SERVICE LIFE WARRANTY

Type	Full Warranty Period	Pro Rata Period
	5 years	5 years
	3 years	7 years
	3 years	7 years
	1 year	9 years
	1 years	9 years
	5 years	5 years
	7 years	0 years
	3 years	17 years
	1 years	19 years
	1 years	19 years
	1 years	14 years

BATTERY OPERATING TEMPERATURES

Annual average battery temperature	Any cell temperature not to exceed for more than 30 days per year
77°F (25°C)	89°F (32°C)

Normal battery float life may be expected only when the battery is operated under the aforementioned temperature conditions. If operation of the battery is not within these parameters, the battery warranty shall be null and void.

Useful service life is considered to have expired when the battery fails to deliver 80% of its rated string capacity. The rated string capacity is that which is published in catalog literature at the time of shipment. The determination of actual capacity shall be made in accordance with the "performance test" guidelines of IEEE Std. 1188. If the battery is maintained per the installation/maintenance instructions and other recommendations contained in this document and fails to deliver 80% of its rated string capacity, shall credit the purchaser (user) toward the purchase of a new battery of equal or greater amp-hour capacity.

The full warranty per Table A and the remainder of designed float service life as pro rata.

$$\text{Credit (\$)} = \text{Original Net Price} \times \left(1 - \frac{\text{Months of Expired Life}}{\text{Months of Warranted Life}}\right)$$

EXCLUSIONS AND LIMITATIONS

1. For batteries stored at a maximum temperature of 77º F (25ºC), the purchaser (user) shall give freshening charges to the battery a minimum of every three (3) months for Lead-Antimony, every six (6) months for Lead-Calcium after shipment from the factory and until final installation. Refer to the installation and maintenance instructions for maximum storage intervals.
2. At least once every twelve (12) months, purchaser (user) must take readings and record information per installation/maintenance instructions. These records must be maintained for warranty claim purposes. If warranty records are not kept, the warranty shall be null and void.
3. This warranty applies only to the original United States and Canada domestic purchaser (user) and is non-transferable internationally, except with the expressed written consent from headquarters in
4. This warranty does not cover physical damage due to the acts of nature or man which stress the battery beyond design limits and exert undesirable influence aside from normal wear and tear.
5. assumes no responsibility for any work accomplished or expenses incurred except with the expressed written consent from headquarters in
6. Movement of batteries from original point of installation shall immediately void this product warranty, except with the expressed written consent from headquarters in
7. Any storage shall be in a dry area having an average ambient temperature of 77ºF (25ºC), or less, and in accordance with published installation/maintenance instructions.
8. **shall not be liable for indirect, incidental or consequential damages arising out of the sale or relating to the use of this product, and the purchaser assumes responsibility for all personal injury and property damage resulting from the handling, possession or use of the product. In no event shall the liability of for any and all claims, including claims of breach of warranty or negligence, exceed the purchase price of the product.**
9. **THE ABOVE WARRANTY IS IN LIEU OF ALL OTHER REMEDIES, INCLUDING BUT NOT LIMITED TO ACTIONS FOR BREACH OF CONTRACT OR NEGLIGENCE. ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE HEREBY EXCLUDED.**

Figure 2 – Second Page of a Typical Standard VRLA Warranty

Specific Manufacturer Warranty Requirements

Often, manufacturers will issue memos or technical notes that detail what voltage, ohmic and other deviation limits that they consider to be within an acceptable range. In other words, readings would have to be outside these limits to process a warranty claim. An example is shown in Figure 3:

	Lower Limit	Upper Limit
Float Voltage Newer batteries (less than 6 months old) Conditioned batteries (greater than 6 months old)	 12.9 V (2.150 VPC) 13.3 V (2.216 VPC)	 14.5 V (2.42 VPC) 14.1 V (2.35 VPC)
Ohmic (Resistance, Impedance, or Conductance) from baseline value or string average	± 50% of 6 months nominal	± 50% of 6 months nominal

The above guidelines apply to:

- 3 or fewer batteries in a string
- For >3 batteries, additional assessment may be required.

The manufacturer does not provide alert/warning level guidance since each customer, application, and service provider has unique requirements.

Figure 3 – Example of Acceptable Ranges from a Typical Battery Warranty

The manufacturer may also lay out additional requirements as shown in the example below (Figure 4):

- Ohmic
  - Baselines are to be established after battery has been in service for 6 months
  - A minimum history of 3 periodic readings with an established baseline with the same ohmic tool and method is required when evaluating ohmic variance to baseline. These records are required to support the warranty claim.
  - All ohmic values from the string averaged together will be used when evaluating ohmic variance to string average. For the most effective data, periodic maintenance ohmic readings are to be taken with the same meter.
  - New batteries added to a string may require additional evaluation
  - Individual voltage and ohmic readings for a full string are required documentation to support the warranty claim
  - A second, repeat reading should be taken of any battery that fails these ohmic criteria to ensure that there was not a measurement error.
  - Actual float voltage of the system must be supplied. This reading should be taken before any ohmic testing is conducted as loads placed on the battery by some ohmic testers will affect the float voltage.
  - Battery unit surface temperature. If the battery is on float, the best place to measure the temperature is the negative post.
  - As with all warranty considerations, application and battery maintenance may impact the life of the battery and warranty coverage

The manufacturer reserves the right in all circumstances to examine and test units reported for warranty. If this testing determines that the product has 80% or greater capacity the warranty claim will be denied.

Figure 4 – Example of Additional Requirements from a Typical Battery Warranty

The Need for Different Warranties for Less Critical Applications and Smaller Batteries

The problem for the user is that not all batteries are large 2 V cells, nor are all batteries protecting significant revenue or life safety. Because of that, many batteries, especially 12 V VRLA units in applications that are not as critical, are not routinely maintained more often than annually. In those cases, the demands for data gathering to meet the standard warranty are uneconomical based on the low revenue of the supported loads and/or the low cost of the individual units. For less critical applications and smaller batteries, it may be wise for the user to work with the manufacturer to come up with a warranty that still protects the manufacturer's interests, but where data-gathering is not as costly. For less critical outdoor telecom cabinets using 12 V VRLA units, the authors consider the warranty shown in Figures 5 and 6, reworked with a different supplier, to be much better:

WARRANTY STATEMENT FOR
VALVE-REGULATED LEAD-ACID STATIONARY BATTERIES

WARRANTY – TELECOM FLOAT SERVICE

[redacted] warrants to the original purchaser (User) that [redacted] batteries shall be free from defects in material and workmanship for a period of (4) years provided the battery has been floated within the manufacturer's recommended float voltage range (as verified by a site visit or maintenance records).

If the battery is not in an air-conditioned environment at altitudes below 3500' in the following states: NV, UT, AZ, NM, TX, LA, MS, AL, GA, SC and FL, the warranty is (3) years.

If [redacted] determines the battery to be defective, it may, at its sole discretion, repair the battery or provide a replacement FOB its factory without charge.

CONDITIONS AND LIMITATIONS- All claims shall be subject to the following conditions and limitations

1. The battery shall be the proper size, design, and capacity for the application.
2. The battery shall be handled, stored and installed in accordance with [redacted] published instructions. Final installation shall be completed 6 months from date of shipment.
3. Initial total battery capacity after a minimum of 48 hours on float charge (when installed within the 6 month period noted above) shall be at least 95% (or 90% for individual monoblocs) of the manufacturer's published value, as verified by an IEEE 1188 commissioning test. As an alternative, an Albér CellCorder or a Midtronics Celltron may be used to test the internal ohmic value of the monoblocs after a minimum of 48 hours on float charge and compare them to Albér, Midtronics, or [redacted] published baselines. If the internal resistance of any individual monobloc is more than 30% above the published baseline (or the internal conductance is more than 23% below the published baseline), a warranty claim may be made.
4. The battery shall be operated in conjunction with a current limited, constant voltage charger, and otherwise operated and maintained in accordance with the [redacted] *Application Manual*.
5. The User shall permit examination of the battery by a [redacted] representative.
6. The battery shall be considered defective if the battery fails to deliver 80% of its rated capacity during the stated warranty period (as verified by an IEEE 1188 performance test). As an alternative, if the battery, when tested with an Albér CellCorder or Midtronics Celltron device, increases in resistance by 40% (or decreases in conductance by 29%) from a baseline value established between months 1 and 12 after installation on that particular monobloc, the battery shall be considered defective for warranty purposes. If no baseline was established on the particular monobloc between months 1 and 12 of its in-service life, the percentage change from Albér, Midtronics, or [redacted] published baseline values at which the warranty will be honored shall be a 50% increase in resistance or a 33% decrease in conductance.

Figure 5 – First Page of a Negotiated VRLA Warranty for Smaller, Less-Critical Batteries

7. This warranty is void if the battery is subject to misuse, abuse or physical damage or if the battery becomes unserviceable due to fire, wreckage, freezing or any act of God, or if the serial numbers have been altered, defaced, or removed.

8. THIS WARRANTY COVERS full warranty replacement and shipping costs, as long as [redacted] has a documented and verified warranty manufactures defect. The warranty does not cover installation costs, circuit breaker resetting or maintenance or service items and further, except as may be provided herein, does NOT include labor costs or transportation charges arising from the replacement of the product or any part thereof or charges to remove same from any premises of User.

9. THIS WARRANTY IS VOID if the user does not start recharging a discharged battery within forty-eight hours.

10. In order for a warranty claim to be considered, a [redacted] *Warranty Claim Form* must be completed and returned to [redacted] for review.

THE ABOVE STATED WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING, WITHOUT LIMITATION, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS. IN NO EVENT SHALL [redacted] BE RESPONSIBLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES OR LOSS, AND EXCEPT AS STATED HERIN, NORTHSTAR BATTERY COMPANY SHALL NOT BE LIABLE FOR ANY DEFECTS IN, OR ANY BREACH OF CONTRACTS RELATING TO THE QUALITY OR PERFORMANCE OF THE ABOVE EQUIPMENT UNDER ANY THEORY OF LAW.

THIS LIMITED WARRANTY APPLIES TO THE ORIGINAL PURCHASER (USER) AND IS NON-TRANSFERRABLE.

RETURNED MATERIALS- In no event shall the User return material to [redacted] without prior written authorization. The User shall be responsible for all costs incurred in returning material and for secure packaging or returned materials to provide the best possible assurance against damage in the shipment. Batteries shall not be returned to [redacted] without special instructions for handling and shipping.

Issued To: [redacted]

Authorized By: [redacted]

[redacted] **Position:** **Western Regional Sales Manager**

Date: **10/22/2013**

Figure 6 – Second Page of a Negotiated VRLA Warranty for Smaller, Less-Critical Batteries

When Would You Want to Do a Discharge Test Regardless of the Warranty Terms?

It cannot be overstated that the only true measure of a lead-acid or nickel cadmium battery capacity is an IEEE 450, 1188 or 1106 performance test. For expensive batteries and/or those protecting very critical applications and a lot of revenue, maintenance regimes should include these periodic performance tests. The IEEE documents generally recommend them at intervals of approximately 25% of the battery's expected life. For lead-acid batteries, 80% of capacity is the knee of the lifetime curve, and is generally accepted as the "end-of-life". Typical lifetime vs. capacity curves for Vented Lead-Acid (VLA) and VRLA batteries are shown in Figures 7 and 8 (assuming the batteries are in a controlled environment), and visually show why a user would probably want to replace their battery when it reaches the 80% capacity point.

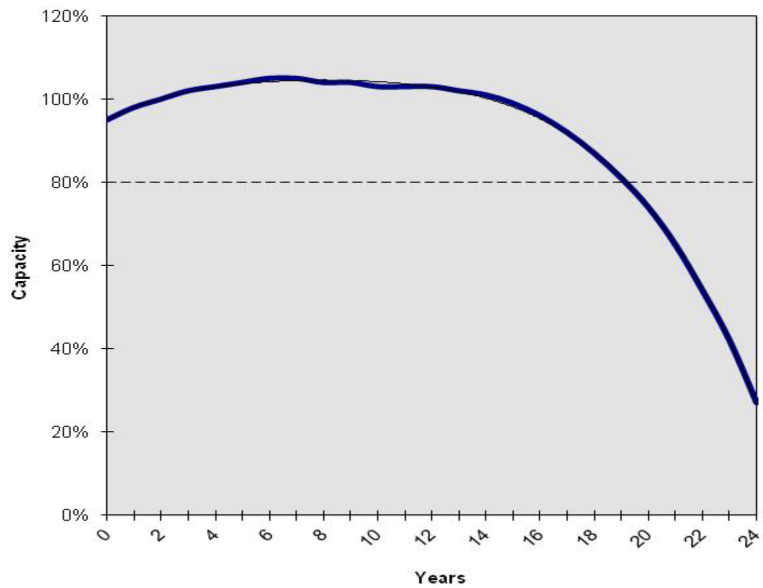

Figure 7 – Typical Life vs. Capacity Curve for a Flooded Long Duration Lead-Calcium Cell

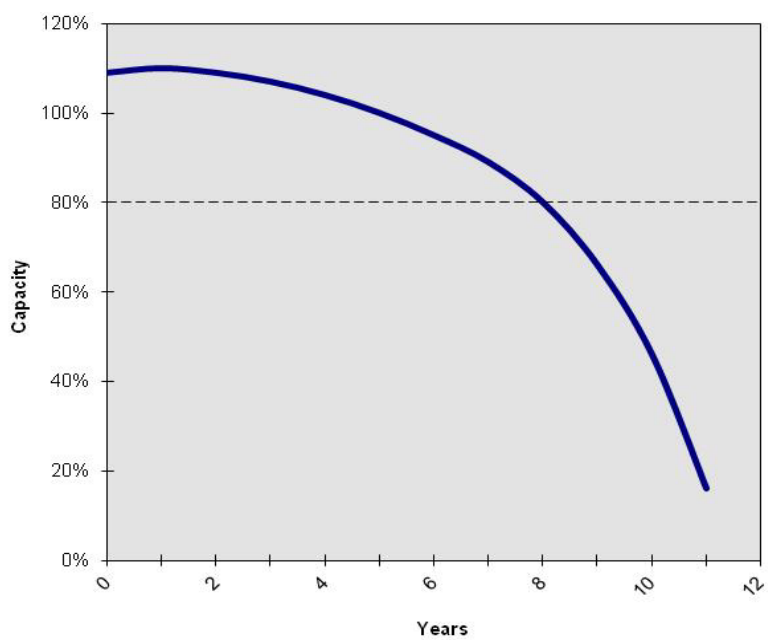

Figure 8 – Typical Life vs. Capacity for a Long-Duration VRLA Cell/Unit in a Controlled Environment

For most Ni-Cd batteries, there is really no other test, other than a discharge test, to determine battery health. For larger medium and long-duration batteries, other methods of determining battery state of health such as an ohmic tests, (although an ohmic test may be used to indicate the need on these larger batteries to perform a full discharge test) are generally not reliable enough for the criticality of the loads these larger batteries are supporting to justify not doing the IEEE recommended performance tests.

When Does an Ohmic Measurement Mean Something?

The test sets used to perform the IEEE performance (full discharge) tests properly typically cost $10,000 or more, and the time to perform the tests (including setup and teardown) can be a full workday or more. In addition, the tests should be done offline, thus (at least partially) exposing the critical load during the test period and during the setup and reconnection. In addition, a temporary battery is usually required to be installed. Many companies do not have the test sets, temporary batteries and/or qualified personnel to perform these IEEE performance tests, so they must vend out this function. A typical contractor cost for a discharge test might be $6,000. That is a small price to periodically pay to know the true health of batteries that cost tens of thousands of dollars and support critical loads where outages can cost millions of dollars. However, it is an expensive price to pay for small sites (such as a telecommunications remote terminal) where the battery plant costs less than $1,000, and the monthly revenue from the site can be less than $1,000.

Therefore, many users of small VRLA batteries (or even VLA engine start batteries) in less critical applications do not perform the expensive IEEE periodic performance tests. Instead, they use only ohmic measurements or other criteria to determine when to replace their batteries.

While using ohmic trending as the only method of determining when to replace a battery is useful for smaller batteries, too many users make the mistake of trying to make a direct correlation between the ohmic reading (vs. the baseline) and the 80% knee-of-the-curve end-of-life point shown in Figures 5 and 6. For example, many users mistakenly feel that a 25% increase in impedance is equal to a 20% drop in capacity (the 80% critical capacity point). There is no such direct correlation (except with super high-current batteries, such as engine start batteries, where the correlation is very strong), as numerous studies have shown, with the most comprehensive (one of the largest in terms of number of cells/units tested) of those probably being the EPRI Study (see Reference 12, and Figure 9).

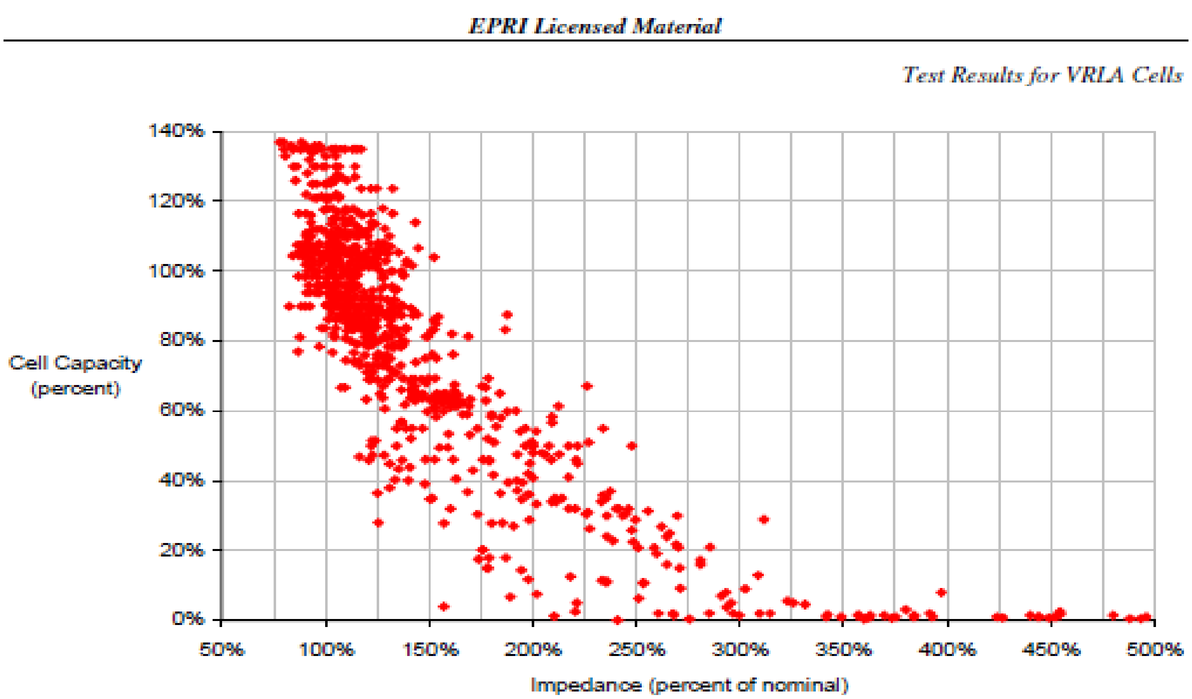

Figure 9 – EPRI Study Correlation (and Lack Thereof) of Ohmic Data to Actual Capacity

However; while there is no direct correlation between ohmic value and capacity, the correlation between having a lead-acid battery that is below the knee-of-the-curve and the percentage increase in internal impedance/resistance above baseline gets stronger the bigger the increase (note that for instruments that measure conductance rather than impedance/resistance, the inverse of the percentage increase must be taken; for example, a 150% impedance value as compared to baseline corresponds to 1 ÷ 1.5, or approximately 67% conductance as compared to baseline). The EPRI study, along with similar studies, is essentially the basis for the IEEE implying (in IEEE 1188) that a user should start to be concerned about VRLA battery health and capacity once the internal impedance has increased to 130% of the baseline value, and to be very concerned when it has increased to 150% of the baseline value.

Figure 10 below is derived from the data of the EPRI study, and is a graphic representation of how the probability of having low capacity individual cells or -units increases as the internal impedance increases (or the conductance decreases). Note that one bad cell/unit can ruin the whole string capacity, so for higher voltage strings, the probabilities of having a bad string are even higher than what is shown in the graph.

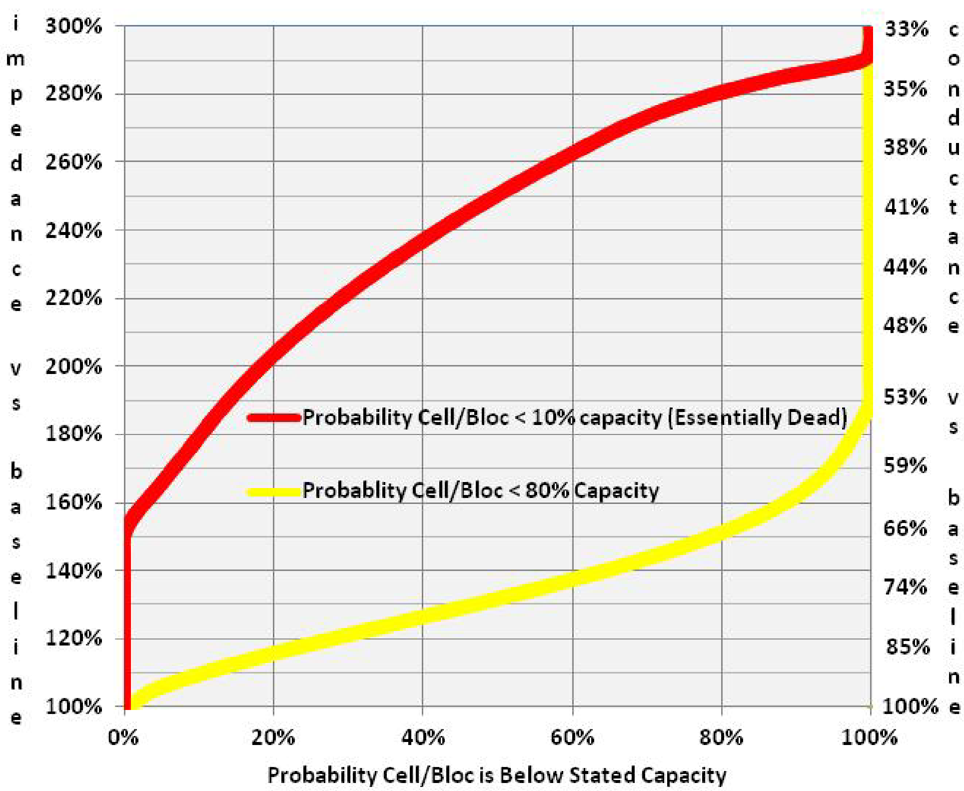

Figure 10 – Correlation of VRLA Ohmic Readings to the Probability of Poor Battery Capacity

The graph shows that at the IEEE 1188 initial concern point of a 30% increase in internal impedance/resistance (corresponding to a 23% decrease in conductance), there is approximately a 50% probability for each individual cell/unit that they are below the knee of the lead-acid lifetime curve of 80% actual capacity. At the upper bound of the IEEE 1188 recommendation for concern (a 50% increase in internal impedance/resistance, which corresponds to a 33% decrease in conductance), it is probable that about 80% of the individual cells/units are below the knee of the lifetime curve. The 50% internal impedance/resistance increase point is well-chosen, because before this point, the chances of having a completely dead cell are extremely low, but start increasing after this point (see the red line in the graph).

Based on the data mentioned already in this paper, many battery manufacturers will agree to a warranty for smaller VRLA units (or sometimes even for 2 Volt VRLA cells) based solely on ohmic readings. Depending on the manufacturer, the warranty claim “set point” could be anywhere from a 30-60% increase in internal impedance/resistance from baseline. In fact, some manufacturers even differentiate the warranty setpoint based on how the baseline was obtained.

IEEE 1188 suggests that the best ohmic baseline is one that is gathered approximately 6 months after the battery has been installed. However, not all users of small VRLA units have routines that allow them to get to all sites at approximately 6 months after installation; so in the experience of the authors of this paper, it is best to try to negotiate a warranty based on a baseline ohmic reading obtained between months 2-12 after battery installation. Any ohmic baseline gathered in this range is probably going to be very close to the baseline obtained after 6 months of installation.

There are cases where the user had no ohmic test set to gather data in the first year after installation, or failed to gather it, or the ohmic test set they were using failed and is now manufacturer-discontinued, so now they are using a different test set (which due to its differing data-gathering algorithm, is probably not going to correlate to the baseline gathered with the original test set). In these cases, where there is no valid individual cell/unit baseline from the first year of life, a manufacturer-published baseline (which could be from the battery manufacturer, or from the ohmic test set manufacturer) for that specific battery model may be used. Because a published baseline is never as good as an individually-measured baseline, some battery manufacturers have different warranty claim set points for published baselines vs. actual baselines. For example, one battery manufacturer the authors are aware of will honor the warranty when the internal impedance/resistance has increased by 30% over a baseline gathered between months 3-6. However, if there is no such baseline, they offer a published list of baseline values for their battery models, and they will honor the warranty if the internal impedance/resistance increases by 40% or more from that published value.

Temperature Concerns

One of the two surest ways to kill a lead-acid battery quickly is to expose it to prolonged high temperatures. In sites like telecommunications outdoor RT cabinets that are not air-conditioned, this is unavoidable; thus a manufacturer would not want to offer the same length of warranty for that type of site as they would for a site that has HVAC. One way of dealing with this in a warranty is to have differing warranty lengths based on climate zones (where typical temperatures are known, such as the example towards the top of Figure 3, where individual states are broken out for differing warranty treatment), rather than require frequent data gathering of temperature data at such small remote sites, where such data gathering is likely to be infrequent or non-existent.

For sites with HVAC systems where temperature is supposed to be controlled, sometimes that equipment fails, or it is improperly set to keep the batteries at optimal temperatures which are usually 20-26 °C (68-80°F). To ensure that the battery is not permanently exposed to temperatures that will shorten its life, most warranties specify some frequency of temperature data gathering in controlled environments. Since most VRLA cells/units in non-UPS applications do not have permanent monitoring and may be visited infrequently, the authors would like to suggest that the frequency of this temperature data gathering need be no more often than semiannually, preferably in the hottest and coldest months.

Proper Float Voltage Concerns

The second of the two surest ways to prematurely end the life of a battery is to float it at the wrong voltage (too high or too low). Therefore, most battery manufacturer standard warranties include requirements for periodic gathering of the float voltage. Similarly to the temperature gathering requirements, the authors would like to suggest that for VRLA units in non-UPS applications that this data needs to be gathered no more often than annually, since even if float voltage is improperly set, it is highly unlikely to change any more often than the scheduled maintenance visits.

It is important that the float voltage be properly set during installation in accordance with the manufacturer's requirement. All too often the charging equipment is factory set at a nominal voltage that may not be suitable for the battery being installed. The float voltage is determined by the specific gravity of the battery's electrolyte and this can be different from manufacturer to manufacturer even for similar models.

Some manufacturers may also require individual cell/unit float voltage readings (in addition to the float voltage of the DC bus) at the same or lesser frequency. The nice thing about ohmic test sets is that almost all of them on the market gather the cell/unit voltage along with the internal ohmic value, and some even record the temperature.

Ripple Current

After improper voltage and temperature, the number 3 killer of batteries is high dc bus ripple. Tracking this periodically (at least annually) is important, and may be in the battery warranties for applications (such as most UPS) that typically have higher ripple, since dc filter capacitors (or less commonly, inductors or chopper circuits) can go bad, thus increasing the low frequency ripple (below 1 kHz)on the dc bus thereby shortening battery life.

User Responsibilities for Data Storage

Even when data gathering requirements are infrequent in the negotiated warranty, the user still needs to be certain to track ohmic, temperature, and float voltage(s) measurements. Ohmic test sets are typically capable of downloading their data to a computer, and many of them have associated printers that can print out the test results. In order to avoid losing the data, the user would be wise to print a copy of this data (writing down the temperature on the printout if the test set doesn't gather that) and leave it in the battery logbook on site (or keep it in their office or in their truck for remote cabinet sites). In addition, they should download the data to their computer, and periodically back that data up.

Full Replacement vs. Pro-Rata

Standard battery warranties typically include a "full replacement" interval for a number of years/months, followed by a pro rata cost interval.

The reason we've put "full replacement" in quotes is that there are often arguments between the user and supplier when it comes time to honor the full replacement warranty regarding whether "full" includes shipping costs and/or labor. The authors don't have a position on whether it should or not, but what "full" means should be clearly spelled out in a negotiated warranty as to whether it includes either, none, or both of these two items. If it is clearly spelled out, then there is no argument.

As has been covered in other Battcon papers, warranty term is an insurance policy. For a longer warranty, you are generally going to pay more money up front. It is the same for the length of the "full replacement" period vs. the pro rata period. Generally, the authors prefer longer "full replacement" periods with no pro rata period. This is because a significant portion of the cost of a battery replacement is in installation/removal labor. Therefore, the authors would prefer, for example, a 7 year true (including shipping and installation/removal costs) full replacement warranty with no pro rata, to a 3 year "full" plus 17 year pro rata warranty.

Summary

To avoid bad feelings down the road, and reduced business between companies, it is in the best interest of both the battery supplier and the end user to negotiate warranties that are realistic for the battery type, application, battery cost, and criticality of the load. This will generally mean modifying the terms of the standard warranty offered by the manufacturer.

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