APPLICATION NOTE

Battery Ohmic Data Analysis

After we gather the impedance data what do we do with it? How do we make sense of it? A battery string consists of more than just batteries. All aspects of it need to be examined.

Examine Float Current

Float current is DC current that may be going through the string.
By measuring float current we are verifying the battery string is not in the process of charging. If we see high float current then the string is charging and the plates are partially sulfated. We do not perform an ohmic test in this condition. The values measured will not be relatable to previous measurements.

CHARGER						
MANUFACTURER:	Best Ferrups	BATTERY FLOAT CURRENT:	0	CHARGER CURRENT:		Amps
MODEL:	FD7.0kva	BATTERY RIPPLE CURRENT:	1.1	CHARGER VOLTAGE:	54.00	Volts
		TEST AC CURRENT:	11.3	EQUALIZATION VOLTAGE:	56.40	Volts

Examine Ripple Current

Ripple current is AC current that may be going through the string.
By measuring ripple current we are examining the state of health of the battery charger. High ripple currents can mean bad rectifiers in the charger. This will cause excessive heating in the batteries leading to premature failure. Typically ripple current in substation strings should be quite low, unless the charger has failed. In UPS system you can see higher levels of ripple current. IEEE recommends that ripple does not exceed 5A for every 100Ah of battery capacity.

Examine Total String Voltage

By measuring total string voltage we verify the charger settings. If a charger is set too high it heats the battery and decreases their life. If the charger is set too low then the cells remain partially sulfated. The longer they remain this way the harder it will be to reverse this.
This setting should be determined by consulting the battery manufacturers data sheet. Some of these may have values that are de-rated due to temperature. Always consult the data sheet.

Table Summary	Total String Voltage Divisor: 1		Display Impedance: Milli-Ohms		Specific Gravity Table Style: One Reading Per Jar	
Baseline Impedance	Avg. Impedance	Total String Voltage	Total String Voltage Dev. from Charger	Min. Voltage	Max. Voltage	Avg. Temp
0	0.16	53.68	0.3 %	2.17	2.27	

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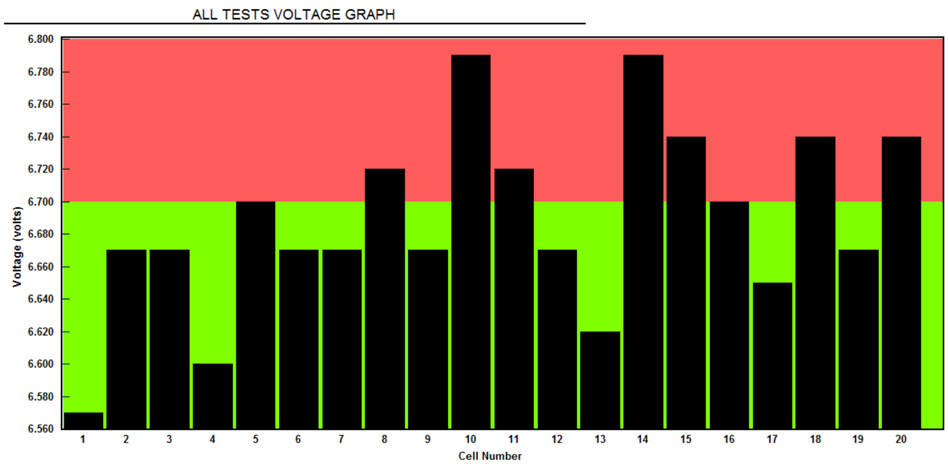
Examine Cell Voltage

By measuring individual cell voltage we measure the balance of the string. When cell voltages vary by more than 1% (on average, again consult the battery datasheet) this is a sign that an equalization should be performed. A battery can act as a source or a load. A battery with low voltage will act as a load on the batteries around it.

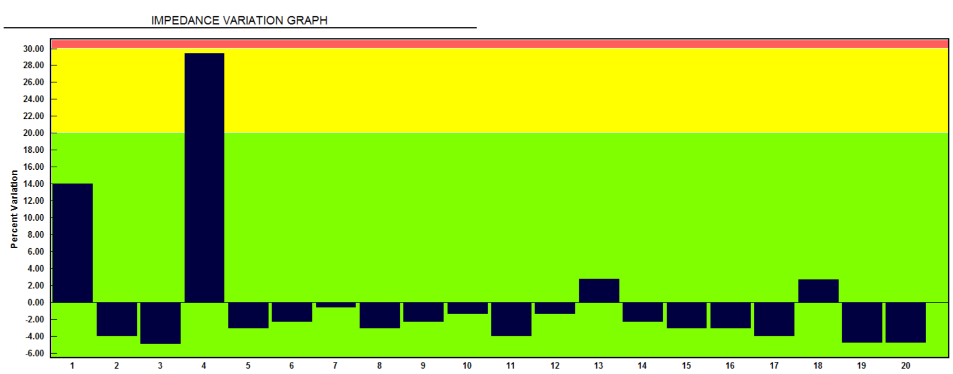


Examine Impedance Variation

Variation means measuring each cells impedance and comparing it to the string average. Measuring the variation from string average helps us locate poor cells.

A string should age at the same rate. If one cell is aging at a higher rate can indicate a problem. By looking at variation this will flag this issue.

High variation form sting average does not necessarily mean a bad cell. It could be a sign of a poor connections causing inadequate charging or it could be a sign that the string needs equalization. If these actions do not correct the variation then it may well be a bad battery. Typically, if a lead acid battery varies by more than 30% from the string average this is a flag to do some troubleshooting.



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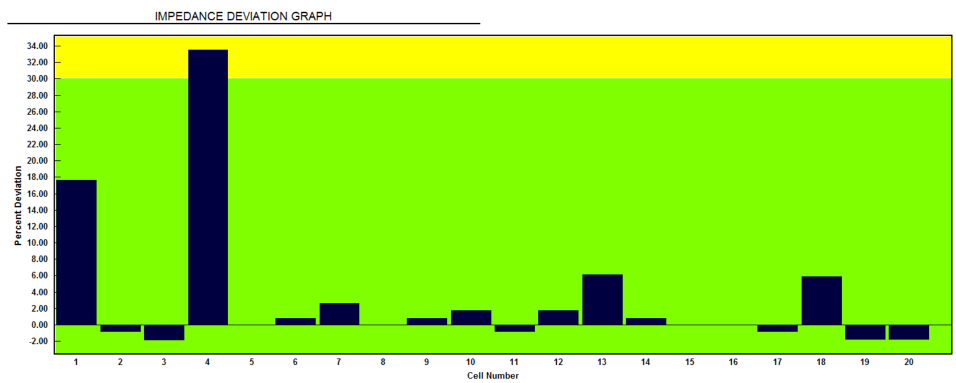
Examine Impedance Deviation

Variation from string average can help us locate a bad cell in the string. However we may find that all the cells are within 5% of each other. They look great. However the entire string has aged significantly. Variation from average will not find this. To check the string health we want to look at deviation from baseline.

Deviation from base line looks at each strings impedance and compares it to the reference string average or baseline that was made the first time the string was tested.

By measuring deviation from baseline we can see how much the entire string has aged. If multiple lead acid cells varies by more than 50% from the established baseline then this is a flag that the string may have low capacity. A discharge test may be in order.

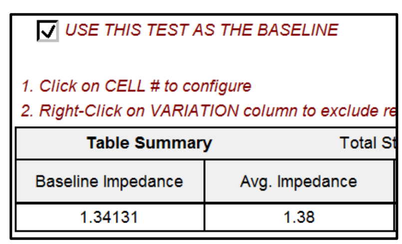
[Please note the limits being giving of 30% and 50% are just starting values. They can vary depending on battery type, application, environment, maintenance…etc. As you perform ohmic testing you may find you need to tighten up or loosen these limits.]



Baseline

Baseline is a reference value used to establish the average impedance of the batteries in the string at the time you started testing the batteries.

The prerequisite for this is that you must know the string is good. It is no sense setting a baseline for a string that has no capacity. In addition the string must be fully charged whenever performing any type of ohmic measurement. If the string is not fully charged then the batteries are partially sulfated and the measurement will not be representative of the battery.



It is best to establish baseline on new string that has completed formation. If the string is older you want to verify it is good. This may mean doing a discharge test first before establishing a baseline value.

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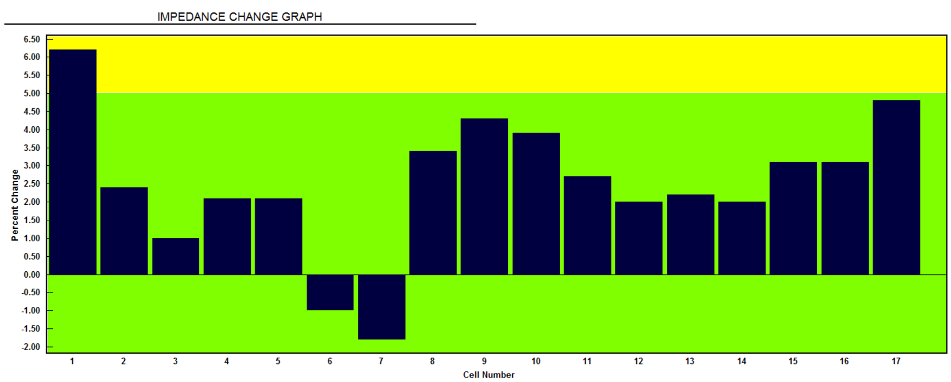
Examine Impedance Change
Measuring change is done when you compare the measurement of each individual cell its own value measured in the previous test.
By measuring each cells impedance and comparing it's change from its previous reading , this helps locate cells that are about to potentially fail. As a cell reaches the end of its life it fails at a greater rate. Typically if a lead acid batteries impedance varies by more than 5 to 10% from its previous test (assuming the tests are being done in proper intervals) this is a flag that the cells may be failing soon.



Examine Inter-cell (Strap) Impedance
Analyzing the battery data is only one part of analyzing the battery string.
Poor inter-cell connections lead to heating as well as poor charging which can lead to sulfating. The longer the cell remains sulfated the harder it is to reverse.
By measuring each inter-cell connections impedance we see how good our connections are. These are the things we may be correcting the most during battery maintenance. If a strap connection varies by more than 20% from the strap average or from its previous measurement then IEEE recommends cleaning and reworking that strap. Corrosion, heating and cooling all effect mechanical connections, so it is not uncommon to be reworking straps.
NOTE: It is recommended to take these measurements from the post. This way the measurement is inclusive of both the inter-cell (strap) resistance and the terminal resistance. (The connection from the post to the strap). These measurements should not be taken from the hardware if at all possible. Also note that stainless steel hardware has a relatively high impedance. If the measurement is taken from stainless steel hardware and not the posts then it is possible that the majority of the resistance you measure will be the hardware and not the actual connections. In this case, where you are using stainless steel hardware and cannot get to the post then it may be better to check the torque. This is not ideal however because you are not measuring the entire connection.

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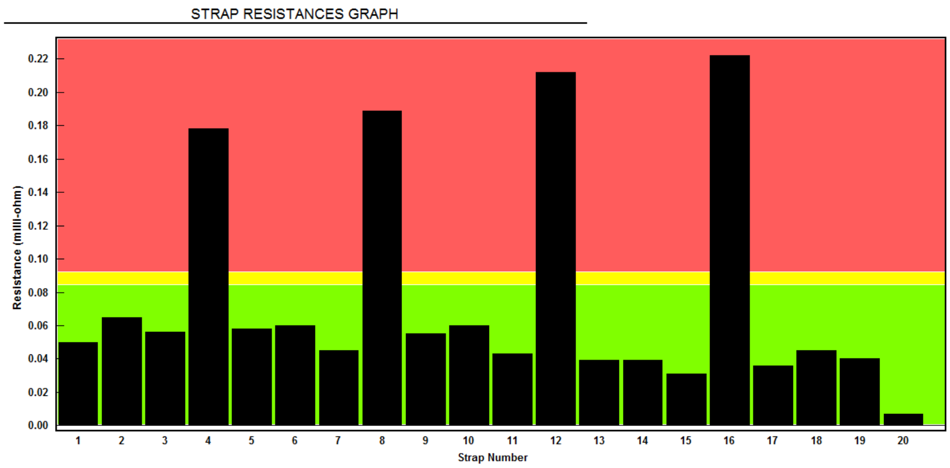

Analyzing NiCD batteries

NiCD batteries have an alkaline electrolyte. This means that material does not readily dissolve into it. For this reason NiCD batteries have a different discharge profile. When they discharge the voltage remains fairly constant until the battery approach the end of capacity. Then the voltage drops quickly. The same holds true of the impedance. As the battery discharges the impedance remains fairly constant until the battery approaches end of charge then the impedance will rise quickly.

This means that when performing an impedance test on a NiCD battery a high impedance measurement over the string average is a sign of a problem cell. However just because a NiCD battery had a good impedance value it does not mean it is good.

This is why it is recommended to perform discharge testing on NiCD batteries. However a preliminary part of discharge testing requires the inter-cell connections or straps to be measured. This can be done using an ohmic tester. In the process of testing the straps it make sense to also test the ripple current, float current and cell impedances. We need to test ripple current and float current anyway. In addition by measuring the cell impedance we can find problem cells before a discharge test is performed.

A high impedance reading is a sign of a bad cell. A battery can also have a low impedance reading. Remember NiCD batteries suffer from dendrite formation and can short out. If we see either a low voltage or a low impedance this can be a sign of dendrite formation. In this case the cell may need to be reconditioned (draining the capacity down and recharging it several times in order to generate enough heat to burn out the dendrites).

http://www.sbsbattery.com

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