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TECHNICAL GUIDE

BATTERY MAINTENANCE – TELECOMMUNICATIONS & INDUSTRIAL TYPES

Regular maintenance and inspections are essential to ensure longest possible service life from telecommunications or industrial batteries. Australian standard AS2676 provides guidance on the inspection, maintenance and testing of batteries. AS2676.2 (1992) sections 6 & 7 are specific to sealed secondary cells. Either the Australian Standard or the manufacturer's instructions must be followed. Failure to undertake and to properly record results of regular maintenance inspections will cause problems should warranty claims be made.

A common misconception is that sealed lead acid (SLA) batteries are "maintenance free". This terminology only relates to a comparison with flooded lead acid batteries, in that water and specific gravity checks are not possible. SLA batteries need regular checks and any abnormalities observed during those checks must be remedied. A small problem in a battery string, if not promptly remedied, will result in a much larger and widespread problem, and in such circumstances failure may not be warrantable.

Operating instructions and brochures for SLA batteries generally only refer to a battery block operating on its own. When SLA batteries (cells) are connected in much larger series and parallel configurations as in UPS or DC systems, the interaction of all the batteries or cells becomes more critical, and this is where routine checking helps ensure good overall long term performance.

Many organizations may take a conscious decision to do limited maintenance, on the basis of the cost savings achieved. Under those circumstances battery life could be reduced. Replacement of batteries will have to be done more regularly. Many technical papers and experience shows that typical service life of well-maintained batteries is about 50% of their design life. A 10 year design life battery may typically have 5 years of service life.

<u>Block or cell voltage convergence.</u>

Regular checks of the individual block or cell voltages must be done. If any blocks or cells diverge from the nominal voltage by more than +/- 2.5% then remedial action must be taken. In a string if a single bloc has a voltage >2.5% above nominal, then it will start to be over charged. Eventually it will fail. Conversely those blocks in the same series connected string will become under charged and will eventually be damaged. The remedy should be to implement a equalize charge. This will temporarily raise the charger voltage to force cells and blocks to equalize. If this does not work, move the affected block/s or cell to a string of similarly affected blocks or cells. Ie put the good ones together and the all the affected ones together. Cell or block voltage convergence is usually worst early in the battery life and gets better over time. The following graph shows a typical cell convergence range for 2V blocks based on a float charging voltage of 2.25VPC. For 6V or 12V batteries the chart values will be 3 or 6 times the 2V value respectively. At temperatures other than nominal, the float voltage will be adjusted accordingly. Convergence of cell voltages is worst when the battery is young and improves over time as the battery chemistry stabilizes.

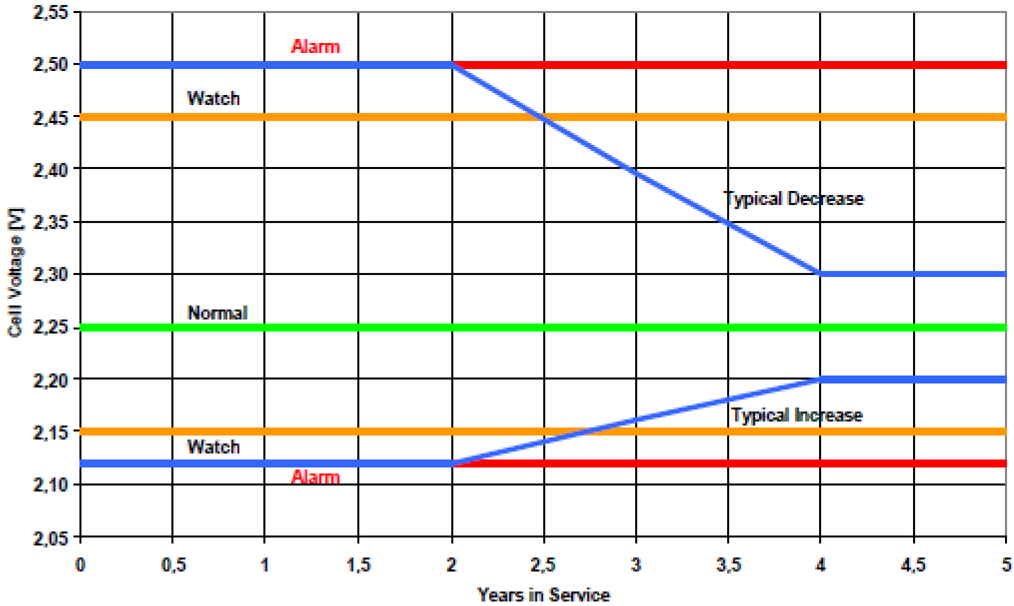


Chart Float Voltage Deviation in VRLA Batteries based on F. Kramm, Dr. H. Niepraschk (Akkumulatorfabrik Sonnenschein GmbH): "Phenomena of Recombination and Polarization for VRLA Batteries in Gel Technology", proceedings INTELEC 1999

Block or cell temperature difference.

Regular checks of the individual block or cell temperatures must be done. If any blocks or cells diverge from the nominal temperature by more than +/- 3 °C then remedial action must be taken. Causes of the abnormal temperature must be determined. It can be that the cell or cells in question are being exposed to higher or lower temperature air flow, or even selective or limited direct sunlight. A cell which is being over charged due to other electrical factors may show a higher than nominal temperature. Whatever the cause of abnormal temperature it must be remedied. All cells or blocks within a single DC system should have very similar operating temperatures.

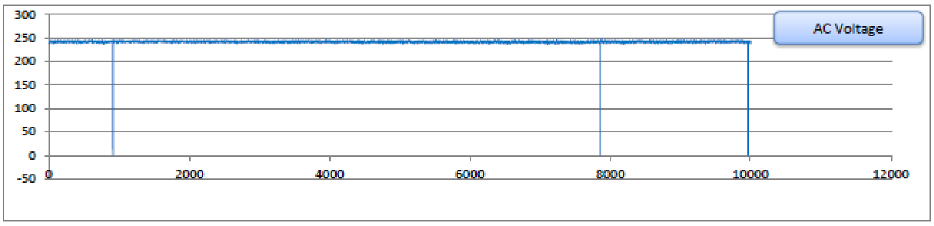
A check must also be made that the charging system temperature sensor reports and acts on a temperature similar to the actual battery cell or block temperature. Failure of the temperature sensor to properly report the actual battery temperature, will result in batteries being either over or under charged.

Block or cell Internal resistance.

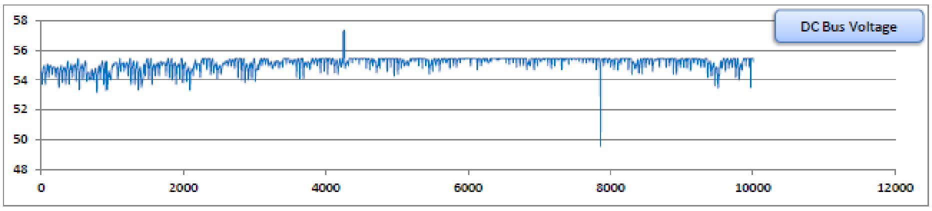
There are many different types of instruments for measuring battery impedance or resistance. There is no standardized approach to doing this, so it is difficult to compare the results of one instrument to another. Also the way the measurement is made affects the result obtained. Most battery manufacturers will not accept IR (internal resistance) testing as proof of battery failure. However, IR testing can provide a good indicator of falling or changing battery capacity. The same instrument should be used and method for measurement consistent. The results of the measurements can then be compared over the service life of the battery. Many instruments such as the Hioki 3551 IR tester, claim that when IR>2* the initial value or base line value, the battery under test is probably reducing in capacity below 80% and needs changing. These IR indicators should be used to instigate proper capacity or performance discharge tests for the purposes of replacement or warranty claims.

Battery Charger Data & Event Logs

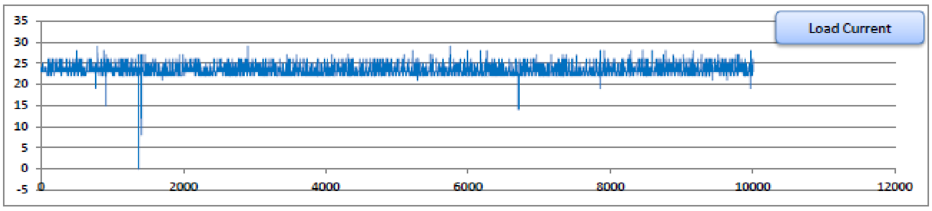
Eaton DC Systems with SC200 system controllers will keep data & event logs limited to typically 10,000 records. These data & event logs should be down loaded during routine maintenance visits and analyzed for abnormal conditions. Information from the data logs can be graphed to show clear departures from normal conditions. Typical information to analyze is the battery temperature, charging or bus voltage, charging current and number of AC power outages. The below graphs show typical data taken from an Eaton SC200 controller and plotted for expert analysis. From the graphs, three (3) AC mains outages are evident, but during none of those events did the DC bus voltage fail (below 42V). Also the average battery charging temperature over the data period was 13^{o}C. The maximum temperature reached 34 ^{o}C on several occasions. Average DC bus (charging) voltage was 55.1V. This data log shows a well charged and operated DC system.



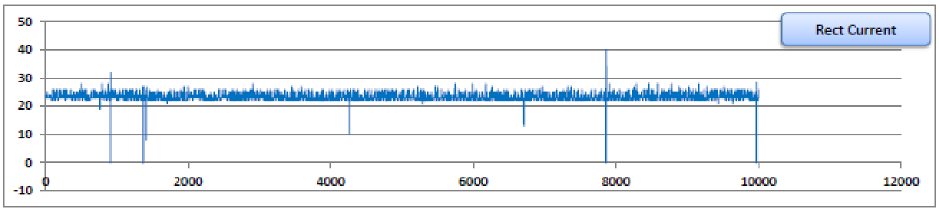
Minimum AC Voltage	0.0
Average AC Voltage	241.7
Maximium AC Voltage	248.0
Qty AC Fail (<90V)	3



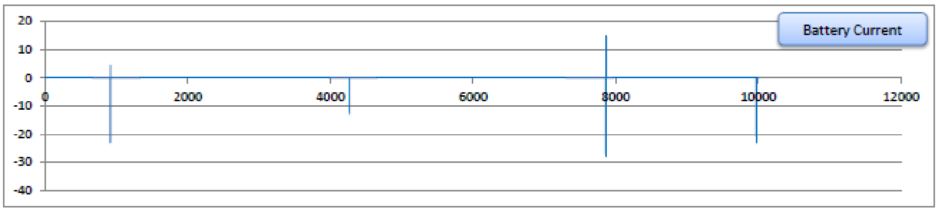
Minimum Bus Voltage	49.6
Average Bus Voltage	55.1
Maximium Bus Voltage	57.3
Qty DC Fail (<40V)	0



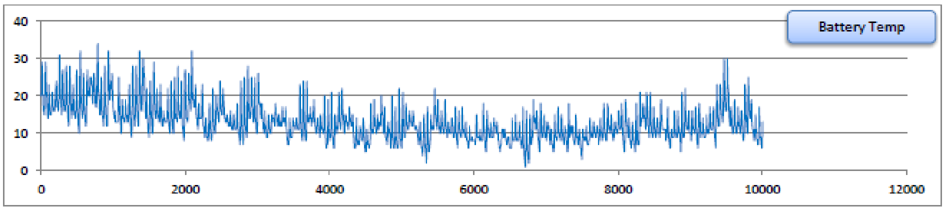
Minimum Load Current	0.0
Average Load Current	23.1
Maximium Load Current	29.0



Minimum Rect Current	0.0
Average Rect Current	23.0
Maximium Rect Current	40.0



Minimum Batt Current	-28.0
Average Batt Current	0.0
Maximium Batt Current	15.0



Minimum Batt Temp	1.0
Average Batt Temp	13.0
Maximium Batt Temp	34.0

<u>Battery Capacity Discharge Test</u>

AS2676.2 details the requirements and procedure for undertaking a battery capacity discharge test. In a capacity test, a battery's ability to deliver a specified current for a specified time is measured. This is the only real test that can determine the health or otherwise of a battery. A capacity test may be carried out on a battery for the following reasons:

(a) To determine whether the battery complies with its specification, or the manufacturer's rating (as appropriate), at the time of commissioning.

(b) To periodically determine whether the capacity of the battery is being maintained.

(c) To determine whether the battery is able to operate satisfactorily at the duty cycle required of it by the d.c. system to which it is connected.

A performance test of the battery capacity should be made as part of the commissioning procedure then periodically (typically every two years or more often for critical back up systems). Results of this test reflect all factors, including maintenance, that determine the battery's capability. It is desirable for comparison purposes that performance tests be similar in duration to the initial test. If on a performance test the battery does not deliver its expected capacity, the test should be repeated.

Inspection schedule according to AS2676.2

Quarterly
The following inspections should be carried out quarterly:
(a) General appearance and cleanness of the battery area.
(b) Charger output current and voltage (*example SC200 data*).
(c) Cracks or distortions in containers or covers.
(d) Corrosion at terminals or connections.
(e) Condition of ventilation equipment when used, and clearance of ventilation openings.
(f) Voltage and surface temperature of the pilot cells.

Yearly
In addition to the checks specified for the quarterly inspection, the following should be inspected.
(a) Tightness of bolted connections to manufacturer's recommended torque, followed by a check of voltage drop across inter-cell connectors.
(b) The integrity of the battery stand or enclosure.
(c) The float voltage of each cell.

A performance discharge test is carried out —

(a) at regular intervals (typically two years but more frequently for some applications, e.g. annually for uninterruptible power supplies and solar power applications) to test the ability of the battery to perform to its nominal capacity (performance test);

(b) to test the ability of the battery to operate at the duty cycle required of it by the d.c. system to which it is connected; and

(c) after abnormal conditions.

Records

Data obtained from inspections and corrective actions are important to the operation and life of batteries. Data should be recorded at the time of installation and as specified during each inspection and should be part of the maintenance procedure. Proper and complete inspection data is essential for any warranty claim.

Data records should include the following:
(a) Receiving inspection data and conditions of charge.
(b) Reports on corrective action.
(c) Reports on capacity and other tests indicating the discharge rates, their duration and results.
(d) Voltage drop across inter-cell connections.

It is recommended that forms be prepared to record all data in an orderly fashion and in such a way that comparison with past data is convenient. A meaningful comparison will require that all data be converted to a standard base in accordance with the manufacturer's recommendations. AS2676.2 contains an example battery test record as shown below.

APPENDIX G
TYPICAL BATTERY REPORT SHEET

BATTERY REPORT — Battery in floating service Sheet No ____________

Manufacturer ____________ Battery Type ____________ Date Installed ____________

Location ____________ Pilot Cell No ____________ (Rotate as needed)

Battery No ____________

Monthly Quarterly

Date and initials or reader	Batt. term. volts	Charger		Temperatures		Date										
		Volts	Amps	Pilot cell	Room	Cell	Volts	Temp.	Volts	Temp.	Volts	Temp	Volts	Temp.	Volts	Temp.
						1										
						2										
						3										
						4										
						5										
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Notes

Annually

Connector bolts Retorqued

Record contact resistance readings and any calculations

Date Range of resistance values intercell connectors

Initial performance test results — Date

Last performance test results — Date

END