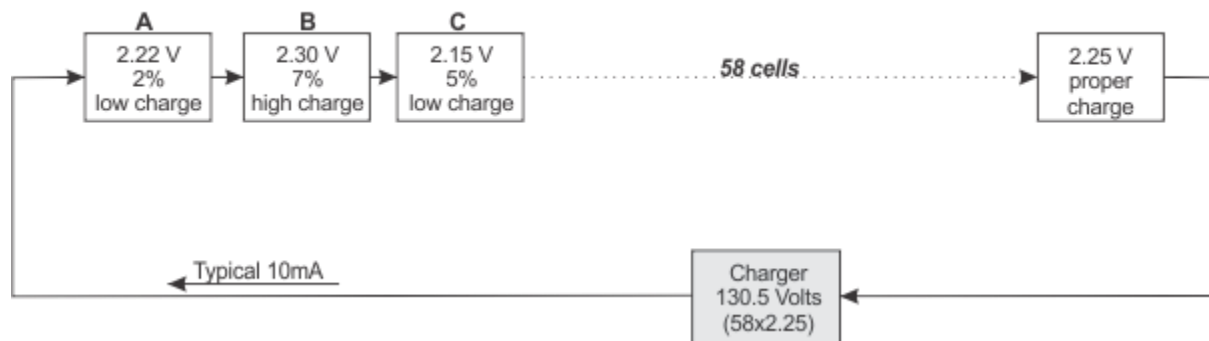


EXTEND USEFUL LIFE AND MAXIMIZE CAPACITY OF LEAD-ACID BATTERIES BY USE OF INDIVIDUAL CELL EQUALIZERS

Series battery strings are used as the main power backup source in many stationary applications. In most applications, the battery string is treated as a single unit and all of the cells within the string are assumed to be identical. This is far from reality. Typically, the individual cells in a battery string have somewhat different capacities and internal characteristics. Differences in cell chemistry (which develop over time) and temperatures leads to differences in cell capacity and level of state of charge. Without **Equalization**, discharging must stop when the weakest cell is empty (even though others have energy left to give).

In a typical installation (Figure 1) some cells do not receive enough current to bring them up to full charge and some receive too much and thus have higher end voltage, out gas and over heat.

Fig. 1 Series Charging of 58 Cells

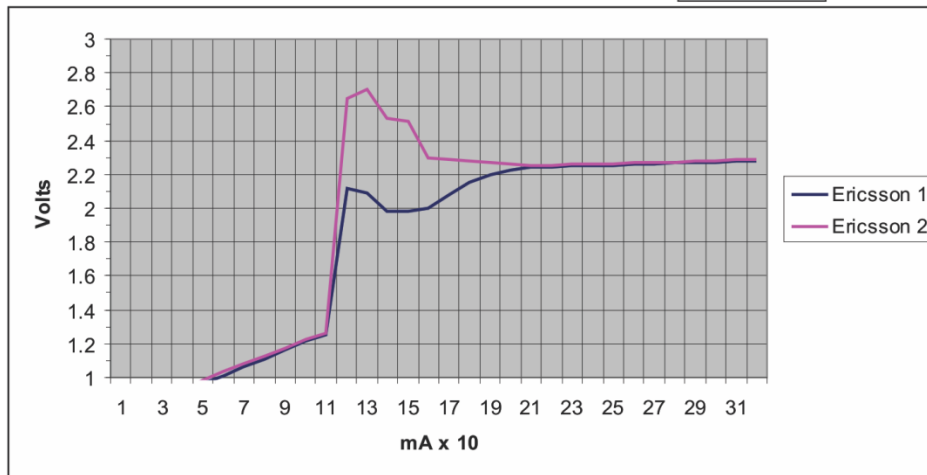
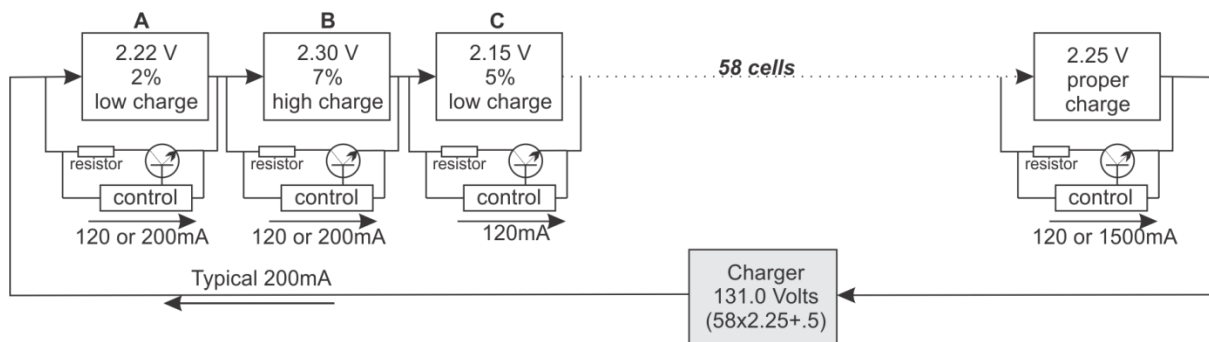


If the voltage becomes too low, the plates will become sulfated and the cell loses capacity. Too high a voltage results in severely decreased cell life.

Regular periodic charging at raised voltage is usually recommended to “equalize the string”, usually at an end voltage of 2.30v to 2.38v per cell. The theory being that at these excessive currents even the weakest cell will get enough to top it up. Manufacturers recommend that for strings of more than 24 cells, the bank be divided into strings of 24 or less. This of course is not possible without taking the bank out of service. Again, these high voltages, which initially will be much higher on the high charge cells, will reduce the mean time to failure of the cells.

A much better approach is to **equalize** each cell individually and continuously while under the float charge. In the early 80’s Ericsson Power Systems Introduced a simple device that attempted to control the individual cell voltage by a use of voltage regulators connected across each cell and thus keep each cell equalized (Figure 2).

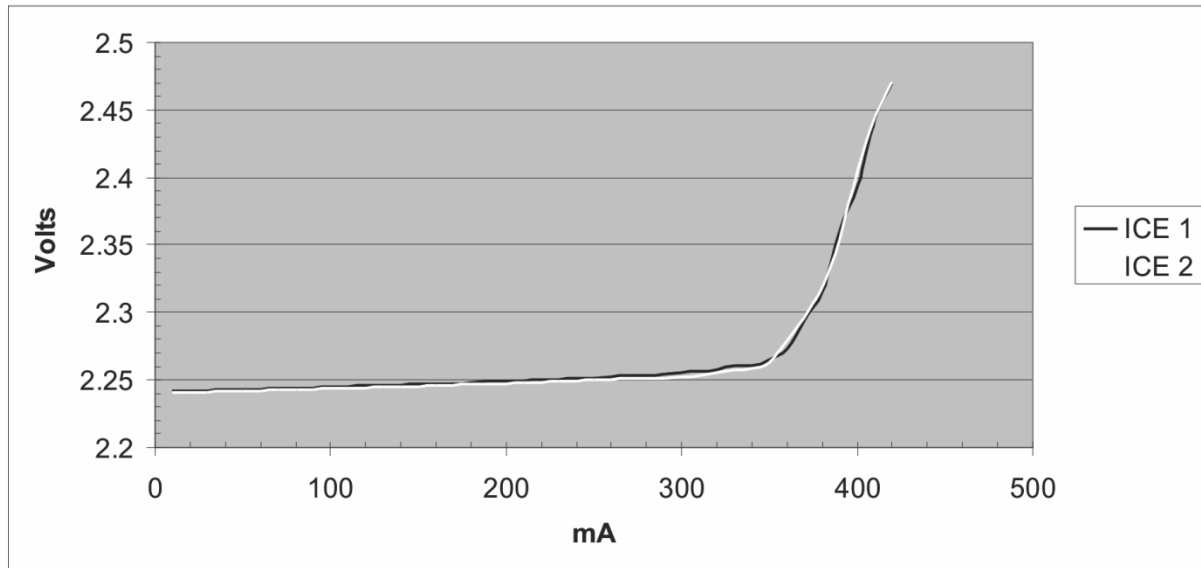
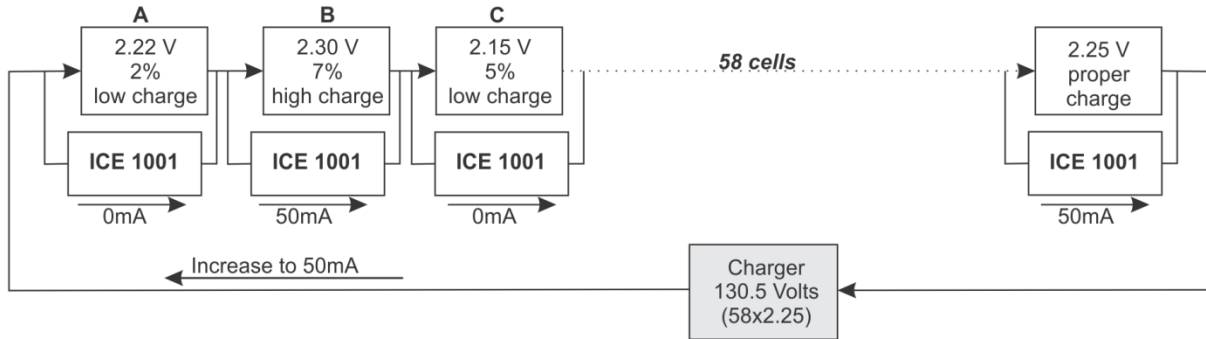
Fig. 2 Voltage regulation of 58 Cells



As you can see at 100mA these devices did not work and thus got a bad reputation in some sites. What is required is to turn the charger current up to 200mA. At this level cells A and C should receive 200mA of charge current, however, as can be seen from the tests done on two different units the results are actually inconclusive. At bypass currents between 110 and 170mA there is no effective voltage control. As the lower voltage cells come up to charge and the bypass current rises, at some point the units lose control and the results are indeterminate. Also in the above example 27W of heat would be generated. The 2.25V regulated level actually varies 1mV per °C of the difference in temperature from 20°C.

A better solution (Figure 2) is the new **Acutix ICE** devices which offer a solution to the above deficiencies in the Ericsson units which additionally are no longer available.

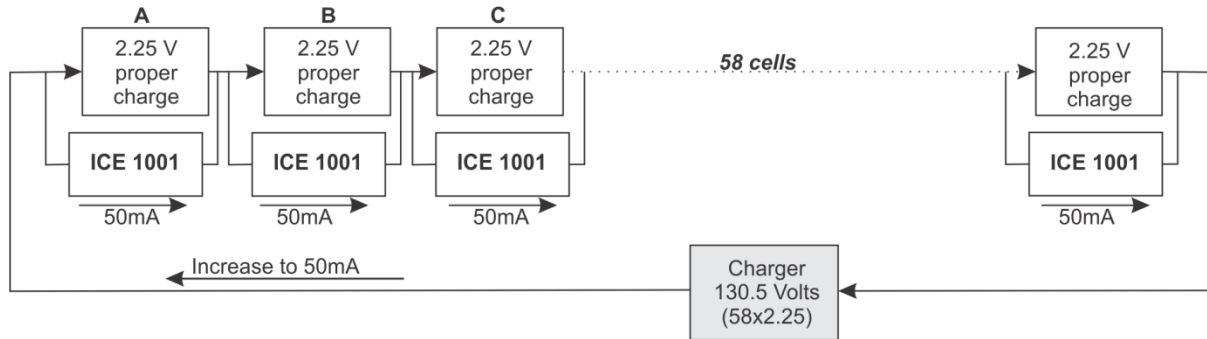
Fig. 3 Individual Equalization of 58 Cells



As can be seen in Figure 3 the ICE 1001 has much tighter control over the cell voltage and is not inconclusive. They self-limit their current at 350 mA and are not temperature sensitive. They are all the same ie: the curves do not vary one unit to another. Also the float current does not have to be increased enough to cause cell heating.

After a time the above example will equalize as is shown in Figure 4.

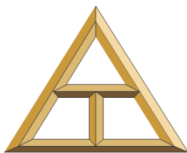
Fig. 4 All cells equalized



- Zero variance between units
- Requires 2mA to function
- $2.25 \pm .01$ Vdc, from 2-300mA*
- Temperature stable (0 to 30 °C = .001v)
- Small size (.75" x 1.25" x .26" / 4oz. / 6" leads)
- Lug size up to 5/16" lug standard - custom terminations available

**available in other voltages*

Cell by cell equalization was and still is a very cost effective solution to extend the useful life of battery banks. The design and implementation of the equalizer has been improved with modern technology so that the tight stable voltage control of each cell is maintained.



DELTATEE INNOVATION LTD.
#202 1439 17 Avenue S.E.
Calgary, Alberta, Canada, T2J 2G7
(888) 745 0202 Fax: (403) 800 0105
www.deltateeinnovations.com

www.acutix.com