CONSTANT POWER SERVICES
TAKING CARE OF BUSINESS

THERMAL RUNAWAY IN LEAD-ACID BATTERIES

INTRODUCTION

This document describes what Thermal Runaway is, how it can occur and its possible causes.

A) WHAT TYPE OF LEAD ACID BATTERIES ARE AFFECTED BY THERMAL RUNAWAY?

For thermal runaway to occur in vented lead-acid batteries, very high extremes of charging current and the resultant high temperature must be present. While this document only considers thermal runaway in VRLA AGM products many of the causes are also applicable to GEL types. It should also be noted that under steady charging conditions, a VRLA AGM cell will normally have a slightly higher internal temperature to the surroundings. Tests have shown that for an ambient temperature of 20°C, the internal temperature will typically be 2°C higher. Similarly, for an ambient of 30°C it has been shown that the internal temperature will be typically 3°C and for 40°C, the internal temperature will be 4°C higher. Some caution has to be used when considering if the increase in temperature is because of the cell size, ventilation and if / or the unit under test is a single cell or monobloc. However, it is well known that the recombination reaction does cause an internal temperature increase.

B) WHAT IS THERMAL RUNAWAY?

Thermal Runaway is defined as a critical condition arising during constant voltage charging in which the current and the temperature of the battery produces a cumulative, mutually reinforcing effect which further increases them, and may lead to the destruction of the battery.

The above can be expanded upon. A lead-acid battery that has been on float charge for some time, typically 3 months, will have a stable float current. If the temperature of the battery increases there is a natural reduction in the back EMF presented by the battery to the charger. The charger will see this and will automatically adjust the current to match the set charging voltage. In so doing, because the current increases a corresponding rise in battery temperature will result. Because the temperature has increased, the back EMF will reduce and again the charger will see this and the charger current will increase, causing additional heat and the cycle is repeated.

It should be noted that a 'type' of Thermal Runaway can also occur when using constant current chargers but there will be no mutually reinforcing effect and instead, the initial current applied will be sufficient to cause the destruction of the battery.

Some typical examples of Thermal Runaway can be seen in Annex 'A'.

C) HOW DOES THERMAL RUNAWAY OCCUR?

Thermal Runaway is explained above but what triggers the cycle of events? There are several reasons.

a. Poor charge voltage regulation. If there is a large swing in the D.C. voltage as a result of the A.C. input voltage variations.

b. Poor ventilation and inadequate cooling normally associated with restricted space in an enclosure or room.

c. Excessive A.C. ripple current from the charger

d. High operating temperatures as a result of the natural temperature such as climatic conditions or being located in a high temperature environment as the result of an outside influence.

e. Poor air circulation in restricted areas which may cool only part of the battery.

f. Restricted air circulation.

ANNEX 'A'

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