

IEEE Standards Interpretation for IEEE Std 1184™-1994 IEEE Guide for the Selection and Sizing of Batteries for Uninterruptible Power Systems

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Interpretation Request #1

Topic: VRLA batteries **Relevant Clause:** Annex B

Annex B states "It is accepted that VRLA batteries are more sensitive to temperature effect than vented cells, but quantitative factors have not yet been identified." Have such factors since been identified?

In the work on revising the Standard, is there any evidence emerging that would support the existence of non-linear or progressive-damage mechanisms in VRLA batteries or even allow the model to be revised to accommodate these effects?

Interpretation Response #1

The life calculation in Annex B is not strictly 'pro rata,' as you imply. It takes its input from the graph in Annex A, which shows that the impact of temperature is exponential (the '% life' axis is logarithmic). Thus, 1 month of operation at, say, 40°C will 'consume' $1/0.34 = 2.94$ months of the battery's life expectancy at 25°C.

This calculation assumes that the time period chosen, one month, is short enough to capture the effects of temperature swings. You may be interested to learn that a similar annex has been included in the latest draft of an update to IEEE Std. 450-1995, with the following text added to the first paragraph:

"When determining the number of intervals to be evaluated, the user should consider the maximum deviation in temperature. Intervals should be selected where the maximum deviation within the interval does not exceed 3°C. Use of intervals with larger temperature variations will result in a less accurate prediction of battery life."

This modification of the original text from IEEE Std 1184 recognizes that large temperature excursions of short duration may have a considerable impact on battery life. A similar modification is planned for the next revision of IEEE 1184. It should be noted that the draft update to IEEE Std 450 is currently being balloted and this text may change.

Note that this calculation does not consider the effects that battery cycling may have on battery life. Nor does it consider the impact of larger changes in individual 'weak' cells.

The issue of quantitative factors for the greater sensitivity of VRLA batteries to temperature has not yet been addressed by the working group; please note, however, that the example in Annex B explicitly refers to electrolyte temperature, rather than ambient. Depending on system design and operating parameters, the operating temperature of a VRLA battery may be higher than that of a vented battery.

There is some additional discussion of temperature issues with VRLA batteries in the IEEE installation and maintenance recommended practices (IEEE Std. 1187 and IEEE Std 1188, respectively), and particularly in IEEE Std. 1189, IEEE Guide for Selection of Valve-Regulated Lead-Acid (VRLA) Batteries for Stationary Applications.