LIFETIME TEST

Performance evolution of linear multilayer acutators

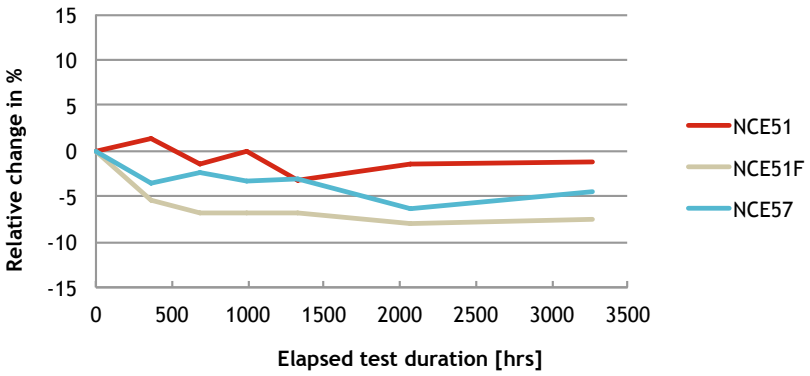
The following document presents the results from a lifetime study conducted at ambient conditions on single tile ceramic multilayer actuators (CMAs).

All measurements were done on linear 5x5x2mm CMAs with a nominal operational voltage of 150V. No mechanical loads were applied to the test samples during test or characterization. AC tests were done at 1kHz, 150V and DC tests at 150VDC. All parts were characterized before test initiation and 100% traceability was maintained throughout the entire test period. After interrupting the test for re-characterization, the samples were left for 16-20 hours before measurement.
The presented numbers are average values which are normalized against measurement results from non tested reference samples. 10 samples from each material were tested in AC and DC operation respectively.

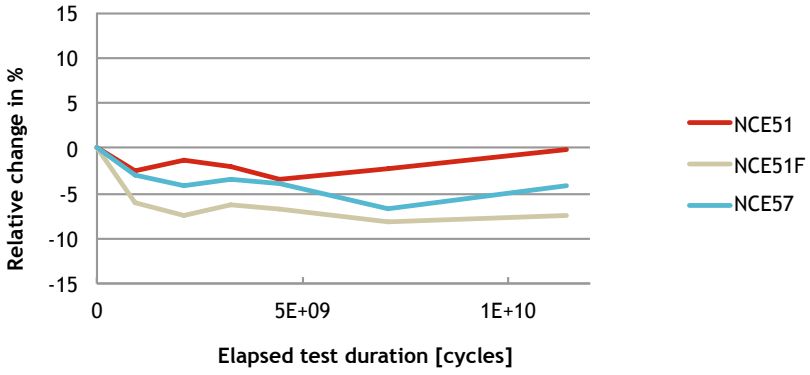
Stroke

From the stroke evolution curves it can be seen that a maximum decrease in stroke of 8% is observed. Measurement uncertainty is estimated to correspond to approximately 3% in the presented graphs, so a maximum stroke reduction of 3 times the measurement uncertainty is indeed acceptable.

Stroke change - 150VDC



Stroke change - 150VAC



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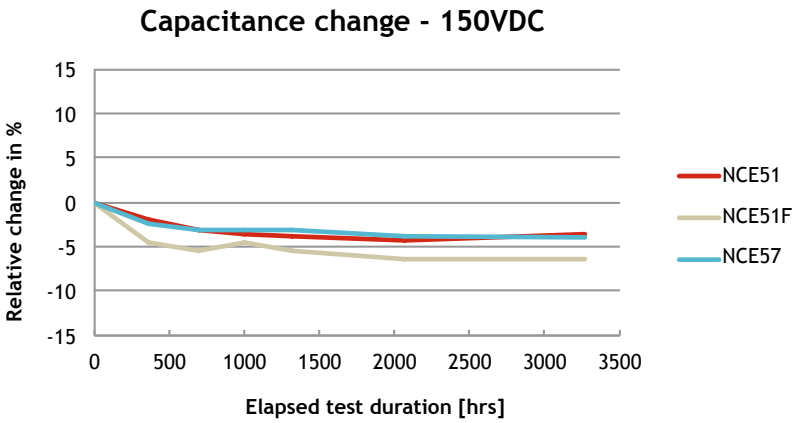
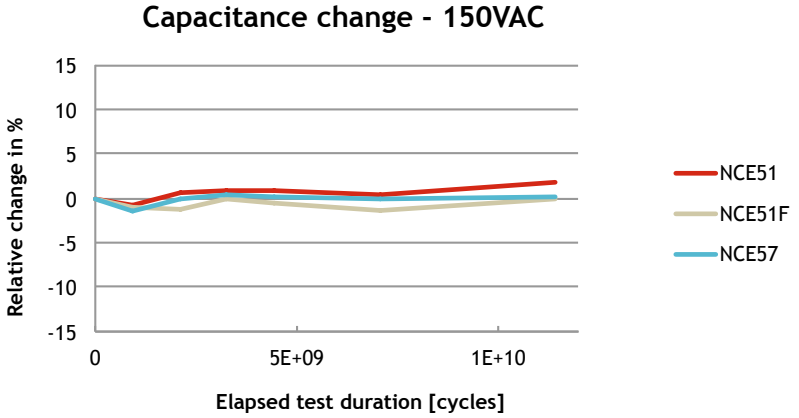
Capacitance

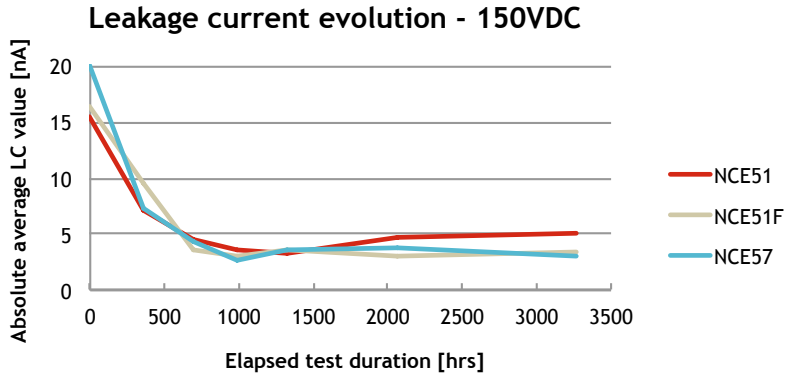
Changes in capacitance as function of elapsed test time are less than 6% difference from “as produced” values. Depending on conditions of use, capacitance decrease on the order of 5-15% could be anticipated. Measurement uncertainty for the capacitance measurement would correspond to 0.01% which must be regarded negligible.

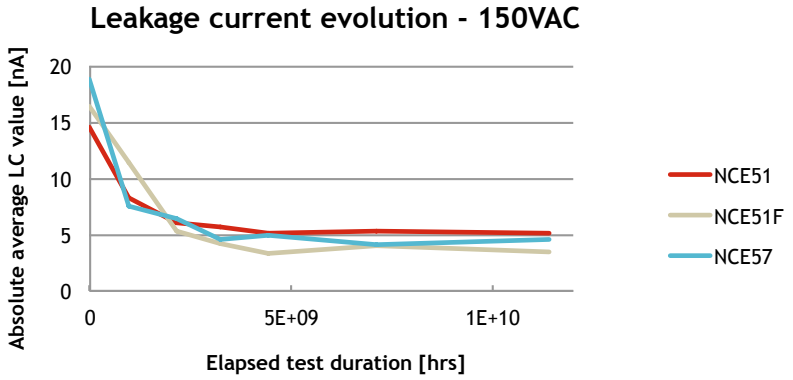




Leakage current

It is normally observed that the leakage current value drops after just a short period of use. Note that the Leakage current curves are absolute values. Due to the low currents involved in the leakage current measurements, the measurement is very sensitive to noise from other equipment and changes in ambient conditions. This sensitivity is affecting the repetition accuracy of the measurement, explaining why little changes can be observed in the leakage current plots.





Summing up

The tested actuators have shown excellent reliability over the entire tested period. From the presented data it can be seen that these actuators can be operated in excess of 3000 hours DC or 1×10^{10} cycles with only minor variations in performance to follow.