

Author: Yuval Hernik & Aaron Ram
Tel: +972-3-557-0852 / 1- 484-321-5317
E-mail: Yuval.Hernik@vishaypg.com;
Aaron.Ram@vishaypg.com

What is “long-term” stability and what are its limitations?

Throughout the meetings Vishay Foil Resistors' (VFR) Application Engineers participated in over the last three years, design engineers have asked many questions relating to precision resistors. Because most reliability test protocols document performance over only 1,000 hours of operation, with some extending to 10,000 hours maximum, the questions were heavily focused on what happens in operational life after these milestones have been reached.

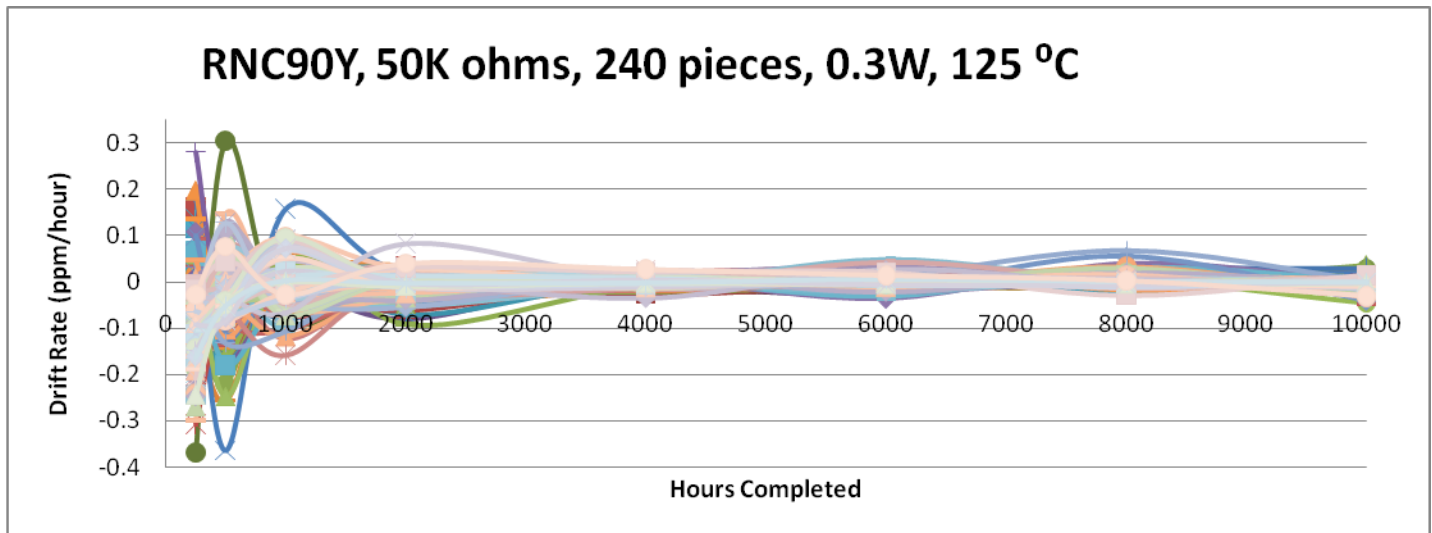
Long-term performance data cannot be documented on every individual resistor because that would, in itself, be the resistor's life cycle and would be classified as a destructive test. Such tests must be conducted on a sampling basis to verify performance of specific lots. No resistor manufacturer can afford to run expensive long-term tests beyond 10,000 hours on every lot, so long-term life tests are usually justified only when a new process is implemented. Testing in excess of 10,000 hours is not traditionally performed even in space applications when the equipment is specified to operate for a significantly longer period of time. Most manufacturers document 1000, 2000, or 10,000 hours of test data and it is “anybody's guess” about the performance afterwards. Additionally, data that classifies components for failure rates in accordance with MIL-STD690, which extends to millions of component-hours, is based on the accumulation of many different resistors, each of which individually runs no longer than 10,000 hours. It should be remembered that a million component-hours can mean anything between one component run for a million hours or a million components run for just a single hour. While the two statements may imply that they have identical results, the actual results have quite different meanings between the extremes of these two sampling plans. The accumulation of failure rate data gives a high degree of confidence about how the component performs up to 10,000 hours, but it says nothing about how any of the resistors perform after 10,001 hours--- regardless of the documented failure rate!

One factor that is often not considered from test data following 10,000 hours is how the drift rate changes over time. Often, a snapshot of the readings from the initial test point is compared to the resistances measured at the end of the test. Vishay Foil resistors have a tendency to stabilize the more they are used, as can be seen by the graph below showing drift rate in ppm/hour compared to the duration of the test. A linear approximation of drift from two test points would not be a valid model for the drift of these resistors. The long term stability of Vishay Foil resistors is thus better than what is indicated by the “load life” specification in the datasheet.

Vishay Precision Group

3 Great Valley Parkway, Suite 150 • Malvern, PA • USA • Phone +1-484-321-5300 • Fax +1-484-321-5301

Example #1 of Load Life tests data:



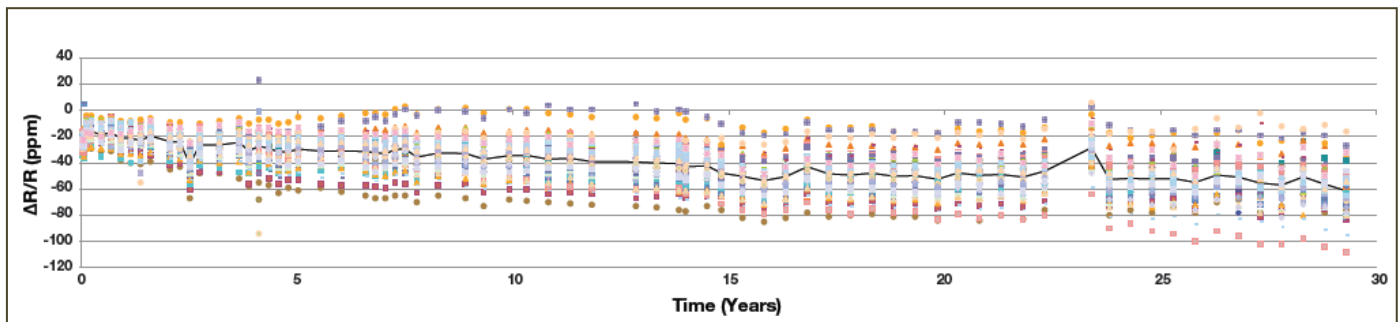
When the Vishay Foil Resistors' Z and Z1-Foil generation of precision resistors were recently introduced, all the qualification testing necessary to document improved performance had been completed. But what about longer-term performance over many years?

Vishay Foil Resistors offers the accumulated data of its S102C series of resistors as evidence of its commitment to provide actual performance documentation over many, many years. The chart below shows the performance of VFR's S102C series resistor over the period of nearly 30 years. VFR is not content to meet just the 10,000 hour life required by existing programs; it continues to offer real data-based assurance that its foil resistors are dependable far beyond the expected life of any other resistor technology.

Z and Z1-Foil performance is being documented and will be available upon request as the years progress, just as we've done for the S102C series – which is still considered to be the most popular precision resistor since its introduction by Dr. Felix Zandman in 1962.

Example #2 of Load Life tests data:

Long-Term Stability Over 29 Years, 0.1W at 70 °C, 50 Samples (S102C, 10K Ω)



For more information about this product group, please contact us at: Foil@vishaypg.com.

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