USE OF THE VIBRATION RESPONSE SPECTRUM TO EVALUATE FLIGHT DATA COMPLIANCE WITH TEST SPECIFICATION LEVELS

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Introduction

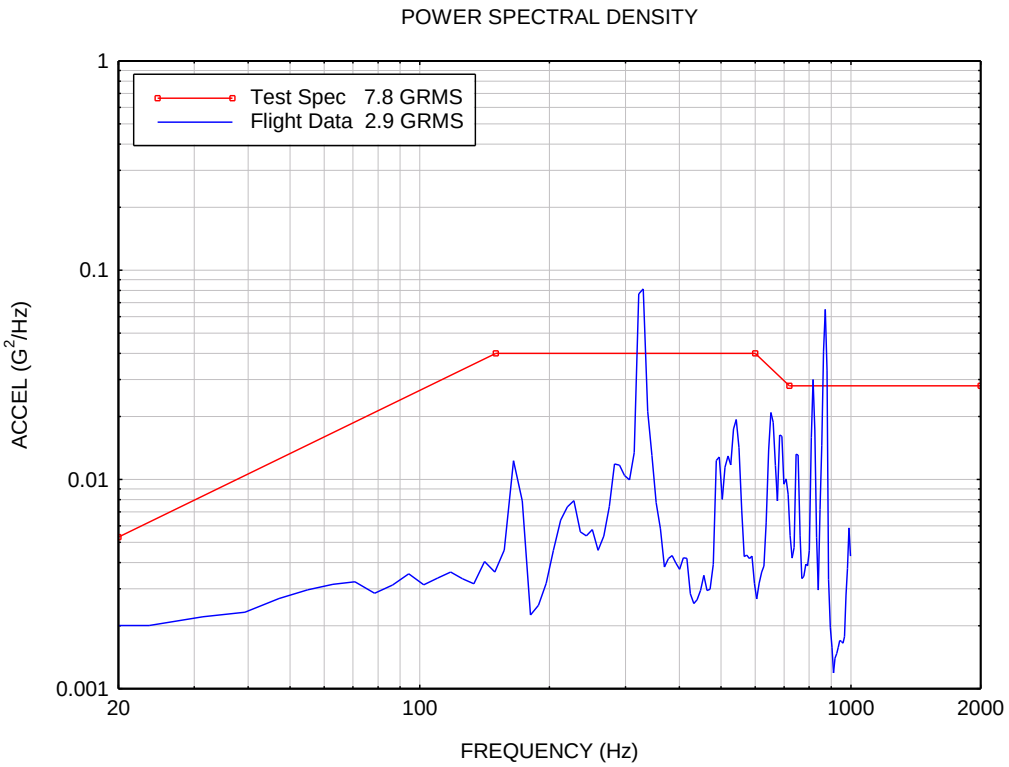

Figure 1.

The data in Figure 1 is from an actual case history. The Test Spec curve is a component acceptance level. The Flight Data curve was measured during the flight of suborbital launch vehicle. The accelerometer was mounted near a component location. The flight level exceeded the test level at 320, 820, and 870 Hz.

Was the component under-tested? Should the test level be increased?

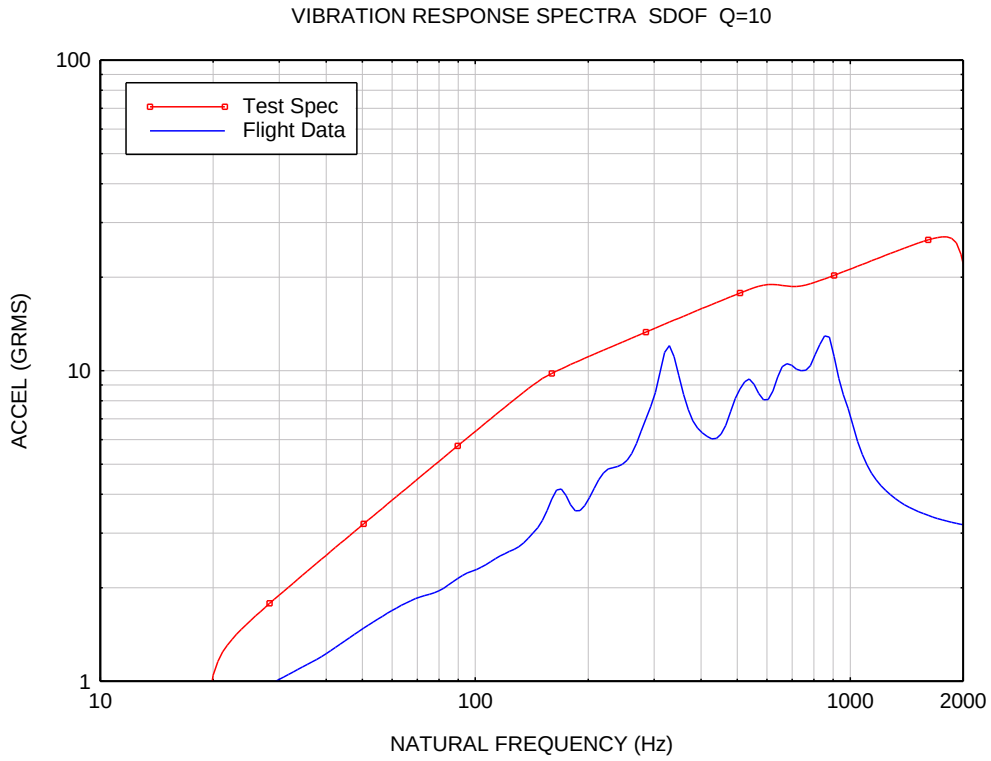

Figure 2.

The vibration response spectrum (VRS) method from Reference 1 can be used to compare the power spectral density curves in terms of the response of a single-degree-of-freedom system to each base input curve.

Assume that the test duration was greater than or equal to the flight event duration.

The resulting comparison shows that the component would have a higher response to the test level than to the flight level regardless of the component's natural frequency. The component was thus adequately tested, with margin to spare.

Thus, there is no need to increase the test level.

Additional Cases

In some cases, a vibration response spectra comparison may show that the flight data and test specification crisscross at several points. A favorable result can still be obtained if the test spec VRS is higher than that of the flight data at the component's natural frequency.

Ideally, the component's natural frequency is known. Otherwise, the VRS comparison can be made over a domain defined by the lower and upper estimates of the natural frequency.

Reference

1. T. Irvine, An Introduction to the Vibration Response Spectrum, Rev D, Vibrationdata, 2010.