METHOD 2026

RANDOM VIBRATION

1. PURPOSE. This test is conducted for the purpose of determining the ability of the microcircuit; to withstand the dynamic stress exerted by random vibration applied between upper and lower frequency limits to simulate the vibration experienced in various service-field environments. Random vibration is more characteristic of modern-field environments produced by missiles, high-thrust jets, and rocket engines. In these types of environments, the random vibration provides a more realistic test. For design purposes, however, a swept frequency sinusoidal test may yield more pertinent design information.

2. APPARATUS.

2.1 Vibration system. The vibration system, consisting of the vibration machine, together with its auxiliary equipment shall be capable of generating a random vibration for which the magnitude has a gaussian (normal) amplitude distribution, except that the acceleration magnitudes of the peak values may be limited to a minimum of three times the rms (three-sigma (α) limits). The machine shall be capable of being equalized so that the magnitude of its spectral-density curve will be between specified limits (for example, see figures 2026-1 and -2). When the test item, or a substitute equivalent mass, is appropriately secured to the vibration machine. The equalization of an electrodynamic vibration machine system is the adjustment of the gain of the electrical amplifier and control system so that the ratio of the output-vibration amplitude to the input-signal amplitude is of a constant value (or given values) throughout the required frequency spectrum.

2.1.1 Control and analysis of vibration.

a. Spectral-density curves. The output of the vibration machine shall be presented graphically as power-spectral density versus frequency. 1/ The spectral-density values shall be within +40 and -30 percent (±1.5 dB) of the specified values between a lower-specified frequency and 1,000 Hz, and within +100 and -50 percent (±3 dB) of the specified values between 1,000 and an upper-specified frequency (2,000 Hz). A filter bandwidth will be a maximum of one-third-octave or a frequency of 25 Hz, whichever is greater.

1/ Power-spectral density is the mean-square value of an oscillation passed by a narrow-band filter per unit-filter bandwidth. For this application it is expressed as G^2/f where G^2/f is the mean-square value of acceleration expressed in gravitational units per number of cycles of filter bandwidth. The spectral-density curves are usually plotted either on a logarithmic scale, or in units of decibels (dB). The number of decibels is defined by the equation:

$$dB = 10 \log \frac{G^2 / f}{G_r^{\,2} / f} = 20 \log \frac{G / \sqrt{f}}{G_r / \sqrt{f}}$$

The rms value of acceleration within a frequency band between f_1 and f_2 is:

$$G_{rms} = \left[\int_{f_1}^{f_2} G^2 / f \, df \right]^{1/2}$$

where $G_r^{\,2}/f$ is a given reference value of power-spectral density, usually the maximum specified value.

b. Distribution curves. A probability density-distribution curve may be obtained and compared with a gaussian-distribution curve. The experimentally-obtained curve should not differ from the gaussian curve by more than ±10 percent of the maximum value.

2.2 Monitoring. Monitoring involves measurements of the vibration excitation and of the test-item performance. When specified, the device shall be monitored during the test. The details of the monitoring circuit, including the method and points of connection to the specimen, shall be specified.

2.2.1 Vibration input. The vibration magnitude shall be monitored on a vibration machine, on mounting fixtures, at locations that are as-near as practical to the device mounting points. When the vibration input is measured at more than one point, the minimum input vibration shall be made to correspond to the specified test curve (see figures 2026-1 and 2026-2). For massive test-items and fixtures, and for large-force exciters or multiple-vibration exciters, the input-control value may be an average of the average magnitudes of three or more inputs. Accelerations in the transverse direction, measured at the test-item attachment points, shall be limited to 100 percent of the applied vibration.

3. PROCEDURE. The device(s) shall be rigidly fastened on the vibration platform and the leads adequately secured. The vibration machine shall then be operated and equalized or compensated to deliver the required random frequencies and intensities conforming to the curves specified in test condition I, figure 2026-1 or test condition II, figure 2026-2. The device(s) shall be subjected to a random vibration specified by the test condition letter (see tables I and II) for a duration of 15 minutes in each of the orientations X, Y, and Z. Where this test is performed as part of a group or subgroup of tests, the post-test measurements or inspections need not be performed specifically at the conclusion of this test.

3.1 Examination. After completion of the test, an external visual examination of the marking shall be performed without magnification or with a viewer having a magnification no greater than 3X and a visual examination of the case, leads, or seals shall be performed at a magnification between 10X and 20X. This examination and any additional specified measurements and examination shall be made after completion of the final cycle or upon completion of a group, sequence, or subgroup of tests which include this test.

3.2 Failure criteria. After subjection to the test, failure of any specified measurement or examination (see 3 and 4), evidence of defects or damage to the case, leads, or seals, or illegible markings shall be considered a failure. Damage to marking caused by fixturing or handling during tests shall not be cause for device rejection.

4. SUMMARY. The following details shall be specified in the applicable acquisition document:

a. Test condition (see 3).

b. Measurements after test (see 3 and 3.1).

c. Test condition I or II and letter (A-K).

d. Test duration if other than specified.

e. Requirement for test to be conducted with device powered up, when applicable.

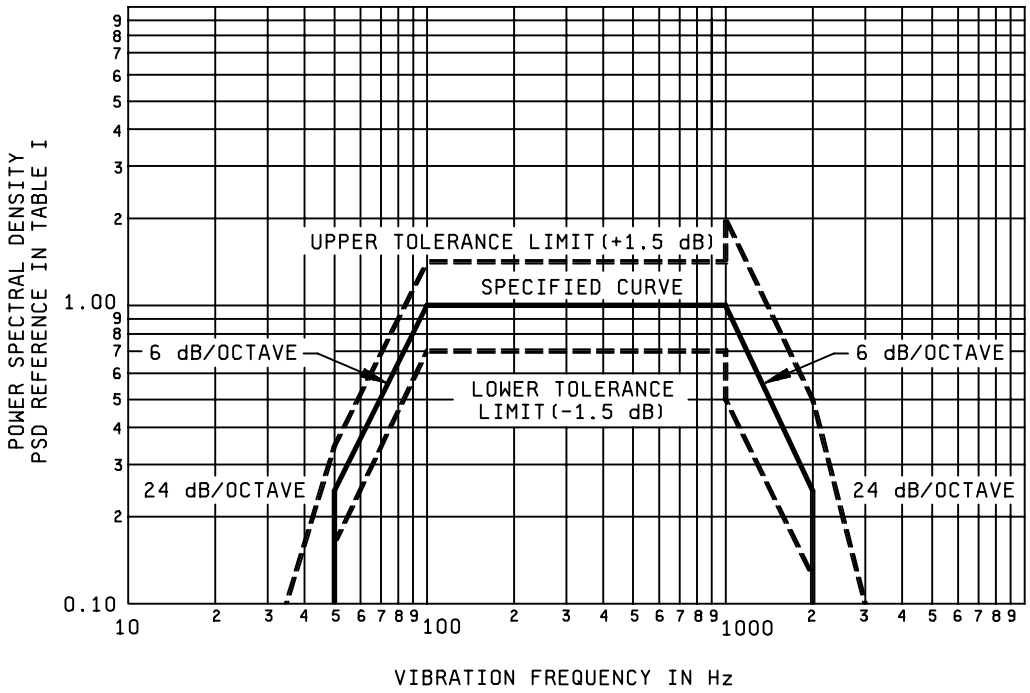

FIGURE 2026-1. Test condition I, random vibration test-curve envelope (see table I).

TABLE I. Values for test condition I. 1/

Characteristics		
Test condition letter	Power spectral density	Overall rms G
A	.02	5.2
B	.04	7.3
C	.06	9.0
D	.1	11.6
E	.2	16.4
F	.3	20.0
G	.4	23.1
H	.6	28.4
J	1.0	36.6
K	1.5	44.8

1/ For duration of test, see 4.

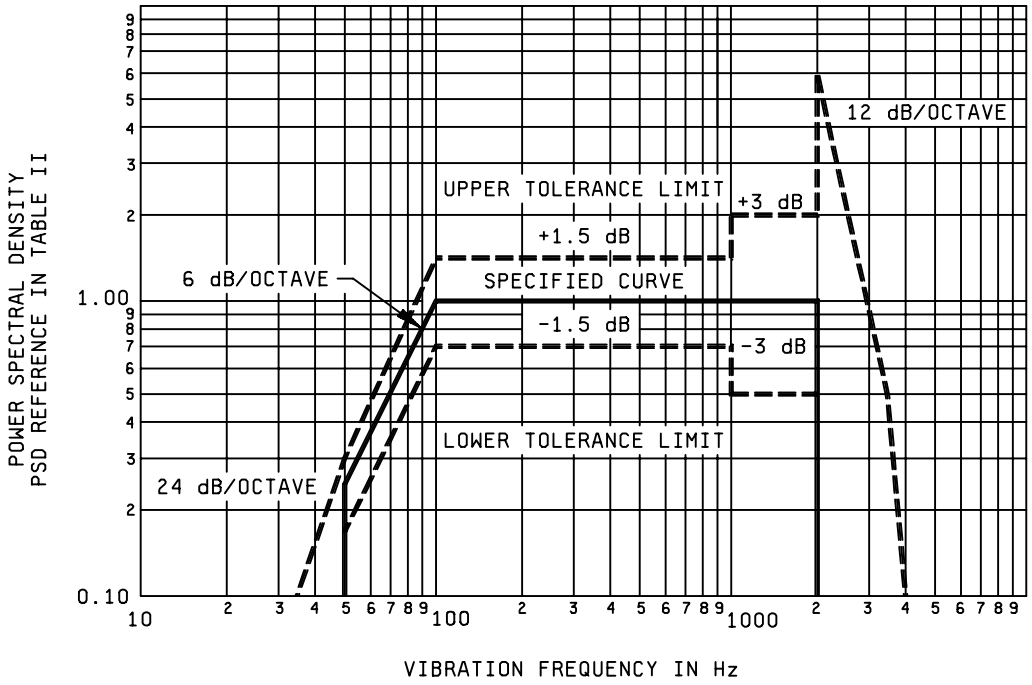

FIGURE 2026-2. Test condition II, random vibration test-curve envelope (see table II).

TABLE II. Values for test condition II. 1/

Characteristics		
Test condition letter	Power spectral density	Overall rms G
A	.02	5.9
B	.04	8.3
C	.06	10.2
D	.1	13.2
E	.2	18.7
F	.3	22.8
G	.4	26.4
H	.6	32.3
J	1.0	41.7
K	1.5	51.1

1/ For duration of test, see 4.