

MIL-STD-202G

METHOD 204D

VIBRATION, HIGH FREQUENCY

1. **PURPOSE.** The high frequency vibration test is performed for the purpose of determining the effect on component parts of vibration in the frequency ranges of 10 to 500 hertz (Hz), 10 to 2,000 Hz or 10 to 3,000 Hz, as may be encountered in aircraft, missiles, and tanks. The choice of test condition A, B, C, D, E, F, G, or H should be based on the frequency range and the vibration amplitude dictated by the applications of the component under consideration, and the state of the component part in relation to resistance-to-vibration damage.

2. **PROCEDURE.**

2.1 **Mounting.** The specimens shall be mounted as specified. For specimens with attached brackets, one of the vibration test directions shall be parallel to the mounting surface of the bracket. Vibration input shall be monitored on the mounting fixture in the proximity of the support points of the specimen.

2.2 **Test condition A (10g peak).** The specimens, while deenergized or operating under the load conditions specified, shall be subjected to the vibration amplitude, frequency range, and duration specified in 2.2.1, 2.2.2, and 2.2.3, respectively (see figure 204-1).

2.2.1 **Amplitude.** The specimens shall be subjected to a simple harmonic motion having an amplitude of either 0.06-inch double amplitude (maximum total excursion) or 10 gravity units (g peak), whichever is less. The tolerance on vibration amplitude shall be ± 10 percent.

2.2.2 **Frequency range.** The vibration frequency shall be varied logarithmically between the approximate limits of 10 and 500 Hz (see 2.10), except that the procedure of method 201 of this standard may be applied during the 10 to 55 Hz band of the vibration frequency range.

2.2.3 **Sweep time and duration.** The entire frequency range of 10 to 500 Hz and return to 10 Hz shall be traversed in 15 minutes. This cycle shall be performed 12 times in each of three mutually perpendicular directions (total of 36 times), so that the motion shall be applied for a total period of approximately 9 hours. Interruptions are permitted provided the requirements for rate of change and test duration are met. Completion of cycling within any separate band is permissible before going to the next band. When the procedure of method 201 of this standard is used for the 10 to 55 Hz band, the duration of this portion shall be the same as the duration for this band using logarithmic cycling (approximately 1-1/3 hours in each of three mutually perpendicular directions).

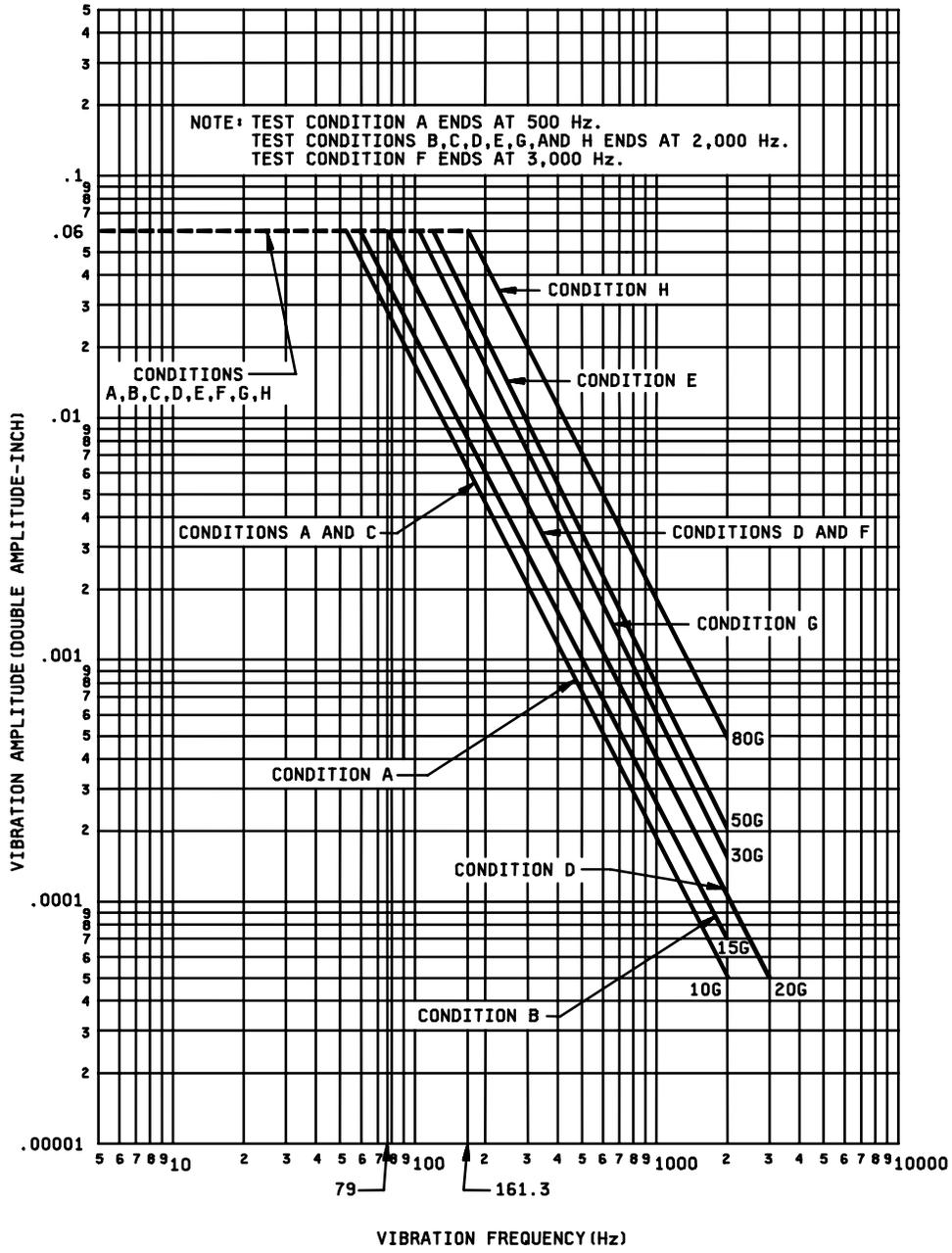
2.3 **Test condition B (15g peak).** The specimens, while deenergized or operating under the load conditions specified, shall be subjected to the vibration amplitude, frequency range, and duration specified in 2.3.1, 2.3.2, and 2.3.3, respectively (see figure 204-1).

2.3.1 **Amplitude.** The specimens shall be subjected to a simple harmonic motion having an amplitude of either 0.06-inch double amplitude (maximum total excursion) or 15g (peak), whichever is less. The tolerance on vibration amplitude shall be ± 10 percent.

2.3.2 **Frequency range.** The vibration frequency shall be varied logarithmically between the approximate limits of 10 to 2,000 Hz (see 2.10), except that the procedure of method 201 of this standard may be applied during the 10 to 55 Hz band of the vibration frequency range.

2.3.3 **Sweep time and duration.** The entire frequency range of 10 to 2,000 Hz and return to 10 Hz shall be traversed in 20 minutes. This cycle shall be performed 12 times in each of three mutually perpendicular directions (total of 36 times), so that the motion shall be applied for a total period of approximately 12 hours. Interruptions are permitted provided the requirements for rate of change and test duration are met. Completion of cycling within any separate band is permissible before going to the next band. When the procedure of method 201 of this standard is used for the 10 to 55 Hz band, the duration of this portion shall be the same as the duration for this band using logarithmic cycling (approximately 1-1/3 hours in each of three mutually perpendicular directions).

METHOD 204D
1 April 1980



$$G = .0512f^2DA \text{ (} f = \text{frequency in hertz, } DA = \text{double amplitude in inches.)}$$

FIGURE 204-1. Vibration-test curves.

2.4 Test condition C (10g peak). The specimens, while de-energized or operating under the load conditions specified, shall be subjected to the vibration amplitude and frequency range shown on figure 204-1. The tolerance on vibration amplitude shall be ± 10 percent.

2.4.1 Part 1. The specimens shall be tested in accordance with method 201 of this standard for 6 hours; 2 hours in each of three mutually perpendicular directions.

2.4.2 Part 2. The specimens shall be subjected to a simple harmonic motion having an amplitude varied to maintain a constant peak acceleration of 10g (peak), the frequency being varied logarithmically between the approximate limits of 55 and 2,000 Hz (see 2.10). The entire frequency range of 55 to 2,000 Hz (no return sweep) shall be traversed in 35 ± 5 minutes, except that in the vicinity of what appears to be resonance, and in order to facilitate the establishment of a resonant frequency, the above rate may be decreased. If resonance is detected, specimens shall be vibrated for 5 minutes at each critical resonant frequency observed. This procedure shall be performed in each of three mutually perpendicular directions. Interruptions are permitted provided the requirements for rate of change and test duration are met.

2.4.3 Resonance. A critical resonant frequency is that frequency at which any point on the specimen is observed to have a maximum amplitude more than twice that of the support points. When specified, resonant frequencies shall be determined either by monitoring parameters such as contact opening, or by use of resonance-detecting instrumentation.

2.5 Test condition D (20g peak). The specimens, while de-energized or operating under the load conditions specified, shall be subjected to the vibration amplitude, frequency, range, and duration specified in 2.5.1, 2.5.2, and 2.5.3, respectively (see fig. 204-1).

2.5.1 Amplitude. The specimens shall be subjected to a simple harmonic motion having an amplitude of either 0.06-inch double amplitude (maximum total excursion) or 20g (peak), whichever is less. The tolerance on vibration amplitude shall be ± 10 percent.

2.5.2 Frequency range. The vibration frequency shall be varied logarithmically between the approximate limits of 10 to 2,000 Hz (see 2.10), except that the procedure of method 201 of this standard may be applied during the 10 to 55 Hz band of the vibration frequency range.

2.5.3 Sweep time and duration. The entire frequency range of 10 to 2,000 Hz and return to 10 Hz shall be traversed in 20 minutes. This cycle shall be performed 12 times in each of three mutually perpendicular directions (total of 36 times), so that the motion shall be applied for a total period of approximately 12 hours. Interruptions are permitted provided the requirements for rate of change and test duration are met. Completion of cycling within any separate band is permissible before going to the next band. When the procedure of method 201 of this standard is used for the 10 to 55 Hz band, the duration of this portion shall be the same as the duration for this band using logarithmic cycling (approximately 1-1/3 hours in each of three mutually perpendicular directions).

2.6 Test condition E (50g peak). The specimens, while de-energized or operating under the load conditions specified, shall be subjected to the vibration amplitude, frequency, range, and duration specified in 2.6.1, 2.6.2, and 2.6.3, respectively (see figure 204-1).

2.6.1 Amplitude. The specimens shall be subjected to a simple harmonic motion having an amplitude of either 0.06-inch double amplitude (maximum total excursion) or 50g (peak), whichever is less. The tolerance on vibration amplitude shall be ± 10 percent.

2.6.2 Frequency range. The vibration frequency shall be varied logarithmically between the approximate limits of 10 and 2,000 Hz (see 2.10), except that the procedure of method 201 of this standard may be applied during the 10 to 55 Hz band of the vibration frequency range.

2.6.3 Sweep time and duration. The entire frequency range of 10 to 2,000 Hz and return to 10 Hz shall be traversed in 20 minutes. This cycle shall be performed 12 times in each of three mutually perpendicular directions (total of 36 times), so that the motion shall be applied for a total period of approximately 12 hours. Interruptions are permitted provided the requirements for rate of change and test duration are met. Completion of cycling within any separate band is permissible before going to the next band. When the procedure of method 201 of this standard is used for the 10 to 55 Hz band, the duration of this portion shall be the same as the duration for this band using logarithmic cycling (approximately 1-1/3 hours in each of three mutually perpendicular directions).

2.7 Test condition F (20g peak). The specimens, while de-energized or operating under the load conditions specified, shall be subjected to the vibration amplitude, frequency range, and duration specified in 2.7.1, 2.7.2, and 2.7.3, respectively (see figure 204-1).

2.7.1 Amplitude. The specimens shall be subjected to a simple harmonic motion having an amplitude of either 0.06-inch double amplitude (maximum total excursion) or 20g (peak), whichever is less. The tolerance on vibration amplitude shall be ± 10 percent.

2.7.2 Frequency range. The vibration frequency shall be varied logarithmically between the limits of 10 and 3,000 Hz (see 2.10), except that the procedure of method 201 of this standard may be applied during the 10 to 55 Hz band of the vibration frequency range.

2.7.3 Sweep time and duration. The entire frequency range of 10 to 3,000 Hz and return to 10 Hz shall be traversed in 20 minutes. This cycle shall be performed 12 times in each of three mutually perpendicular directions (total of 36 times), so that the motion shall be applied for a total period of approximately 12 hours. Interruptions are permitted provided the requirements for rate of change and test duration are met. Completion of cycling within any separate band is permissible before going to the next band. When the procedure of method 201 of this standard is used for the 10 to 55 Hz band, the duration of this portion shall be the same as the duration for this band using logarithmic cycling (approximately 1-1/3 hours in each of three mutually perpendicular directions).

2.8 Test condition G (30g peak). The specimens, while deenergized or operating under the load conditions specified, shall be subjected to the vibration amplitude, frequency range, and duration specified in 2.8.1, 2.8.2, and 2.8.3, respectively (see figure 204-1).

2.8.1 Amplitude. The specimens shall be subjected to a simple harmonic motion having an amplitude of either 0.06-inch double amplitude (maximum total excursion) or 30g (peak), whichever is less. The tolerance on vibration amplitude shall be ± 10 percent.

2.8.2 Frequency range. The vibration frequency shall be varied logarithmically between the limits of 10 and 2,000 Hz (see 2.10), except that the procedure of method 201 of this standard may be applied during the 10 to 55 Hz band of the vibration frequency range.

2.8.3 Sweep time and duration. The entire frequency range of 10 to 2,000 Hz and return to 10 Hz shall be traversed in 20 minutes. This cycle shall be performed 12 times in each of three mutually perpendicular directions (total of 36 times), so that the motion shall be applied for a total period of approximately 12 hours. Interruptions are permitted provided the requirements for rate of change and test duration are met. Completion of cycling within any separate band is permissible before going to the next band. When the procedure of method 201 of this standard is used for the 10 to 55 Hz band, the duration of this portion shall be the same as the duration for this band using logarithmic cycling (approximately 1-1/3 hours in each of three mutually perpendicular directions).

MIL-STD-202G

2.9 Test condition H (80g peak). The specimens, while de-energized or operating under the load conditions specified, shall be subjected to the vibration amplitude, frequency range, and duration specified in 2.9.1, 2.9.2, and 2.9.3, respectively (see figure 204-1).

2.9.1 Amplitude. The specimens shall be subjected to a simple harmonic motion having a constant amplitude of either 0.06-inch double amplitude (maximum total excursion) or 80g (peak), whichever is less. The tolerance on vibration amplitude shall be ± 10 percent.

2.9.2 Frequency range. The vibration frequency shall be varied logarithmically between the limits of 10 and 2,000 Hz (see 2.10), except that the procedure of method 201 of this standard may be applied during the 10 to 55 Hz band of the vibration frequency range.

2.9.3 Sweep time and duration. The entire frequency range of 10 to 2,000 Hz and return to 10 Hz shall be traversed in 20 minutes. This cycle shall be performed 12 times in each of three mutually perpendicular directions (total of 36 times), so that the motion shall be applied for a total period of approximately 12 hours. Interruptions are permitted provided the requirements for rate of change and test duration are met. Completion of cycling within any separate band is permissible before going to the next band. When the procedure of method 201 of this standard is used for the 10 to 55 Hz band, the duration of this portion shall be the same as the duration for this band using logarithmic cycling (approximately) 1-1/3 hours in each of three mutually perpendicular directions.

2.10 Alternate procedure for use of linear in place of logarithmic change of frequency. Linear rate of change of frequency is permissible under the following conditions:

- a. The frequency range above 55 Hz shall be subdivided into not less than three bands. The ratio of the maximum frequency to the minimum frequency in each band shall be not less than two.
- b. The rate of change of frequency in hertz per minute (Hz/min) shall be constant for any one band.
- c. The ratios of the rate of change of frequency of each band to the maximum frequency of that band shall be approximately equal.

2.10.1 Example of alternate procedure. As an example of the computation of rates of change, assume that the frequency spectrum has been divided into three bands, 55 to 125 Hz, 125 to 500 Hz, and 500 to 2,000 Hz, in accordance with 2.10a. Let the (constant) ratio of rate of frequency change in Hz/min, to maximum frequency in Hz be k for each band. Then the rates of change for the three bands will be $125k$, $500k$, and $2,000k$, respectively. The times, in minutes, to traverse the three frequency bands will therefore be respectively:

$$\frac{125 - 55}{55k}, \frac{500 - 125}{500k}, \frac{2000 - 500}{2,000k}$$

Since the minimum total sweep time is 30 minutes,

$$30 = \frac{70}{125k} + \frac{375}{500k} + \frac{1,500}{2,000k}$$

from which: $k = 0.0687$

The required maximum constant rates of frequency change for the three bands are therefore 8.54, 34.4, and 136.6 Hz/min, respectively. The minimum times of traverse of the bands are 8.2, 10.9, and 10.9 minutes, respectively.

MIL-STD-202G

3. MEASUREMENTS. Measurements shall be made as specified.
4. SUMMARY. The following details are to be specified in the individual specification:
 - a. Mounting of specimens (see 2.1).
 - b. Electrical-load conditions, if applicable (see 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, and 2.9).
 - c. Test condition letter (see figure 204-1).
 - d. Method of determining resonance, if applicable (see 2.4.3).
 - e. Measurements (see 3).