ASSOCIATION CONNECTING
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# IPC-TM-650
# TEST METHODS MANUAL

| Number | |
|---|---|
| 3.12 | |
| Subject | |
| Vibration, Connectors | |
| Date | Revision |
| 7/75 | A |
| Originating Task Group | |
| N/A | |

**1.0 Scope**

**1.1** To determine the effect on the connector of the stresses produced by mechanical vibration within the predominant frequency ranges and of amplitudes that may be encountered during field service; two input vibration types are provided:

**Sinusoidal** — Used to determine critical frequencies, modes of vibration, and other data necessary for planning protective steps against the effects of undue vibration. The simple harmonic motion provided by this method is not representative of most vibration encountered during field service.

**Random** — Used to provide a closer approximation to the complex, non-periodic vibration encountered during field service.

**2.0 Reference Documents**

**2.1** Information in this section is intended to parallel the test method described in EIA-RS-364/TP-28.

**3.0 Test Specimen**

**3.1** A connector (plug and receptacle) complete with applicable guide, keying, and engaging hardware or a card-edge receptacle and mating nominal-thickness printed circuit board.

**3.2 Mounting and Termination**

**3.2.1 Right Angle, Two-Piece Connector** The receptacle shall be mounted and terminated normally during this test; receptacles designed for mounting on non-rigid bases (e.g., motherboards, metal-plate back panels, etc.) shall be mounted on the smallest section of such a base that will accommodate the test specimen. The plug shall be terminated normally during this test and shall be mounted on a nominal-thickness printed circuit board extending the full width of the plug; the board shall extend a minimum of four inches from the receptacle when the connector is mated.

**3.2.2 Card-Edge Receptacle** The receptacle shall be mounted and terminated normally during this test (see 3.2.1 ). The mating printed circuit board shall extend the full width of the receptacle and shall extend a minimum of four inches from the receptacle when mated.

**3.2.3 Parallel, Two-Piece Connector** The receptacle and plug shall be terminated normally during this test; both components shall be mounted on nominal-thickness printed circuit boards extending the full width of each. The printed circuit boards shall extend a minimum of four inches from each component when the connector is mated.

**3.3 Fixturing**

**3.3.1 Right Angle Connector** The test specimen shall be held in an adequate resonant free fixture. (Figure 1, Reference example.)

**3.3.2 Parallel Connector** The test specimen shall be held in an adequate resonant free fixture. (Figure 2, Reference example.)

**3.4** The connector shall be wired (or printed circuit boards designed) such that a continuous electrical circuit (comprising all contacts in series) is formed when the plug (or board) and receptacle are mated.

**4.0 Apparatus**

**4.1** An electrodynamics vibration system and associated instrumentation capable of producing the vibration indicated in Table 1 and Figures 3 and 4 as specified in the individual connector specification. The system shall be capable of maintaining the vibratory input within the following tolerances:

| | |
|---|---|
| Displacement | – ± 10% |
| Acceleration | – ± 10% |
| Power Spectral Density | – ± 3.0 DB (50 Hz maximum filter bandwidth) |
| Frequency | – ± 2% |

**4.2** A circuit monitor capable of supplying a continuous current of 100 milliamperes and of detecting discontinuities in this current greater than 1 microsecond.

**5.0 Procedure**

**5.1 Calibration**

**5.1.1** The vibration system shall be set up to provide the sinusoidal or random vibratory input in accordance with

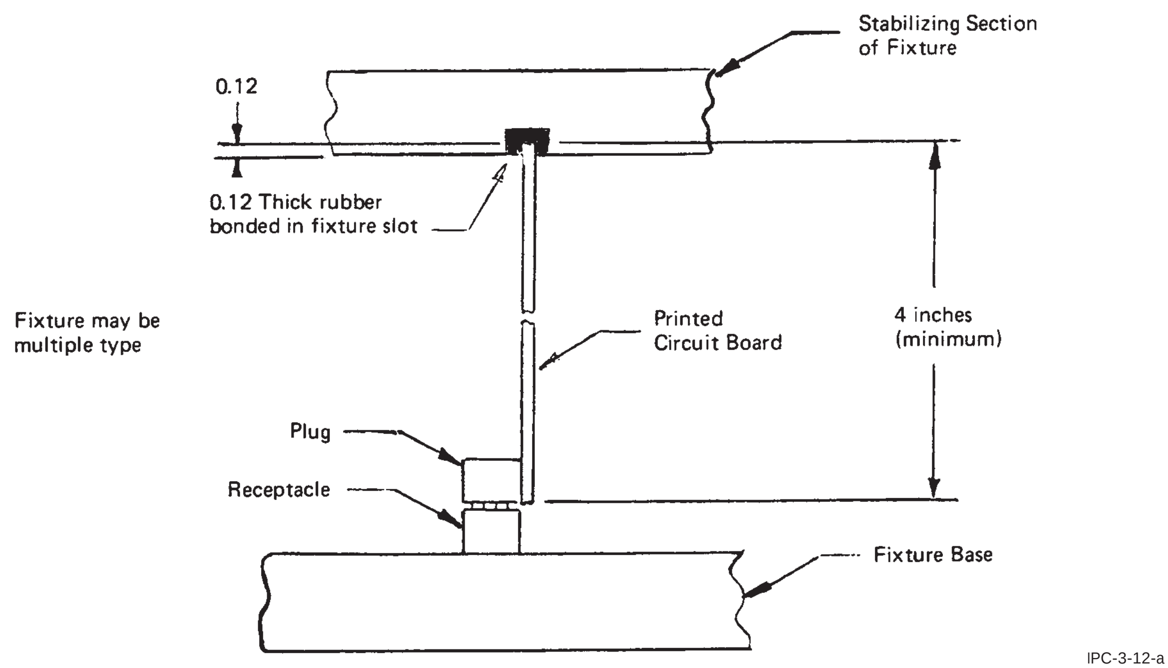


**Figure 1 Right Angle Connector Fixture (Suggested)**

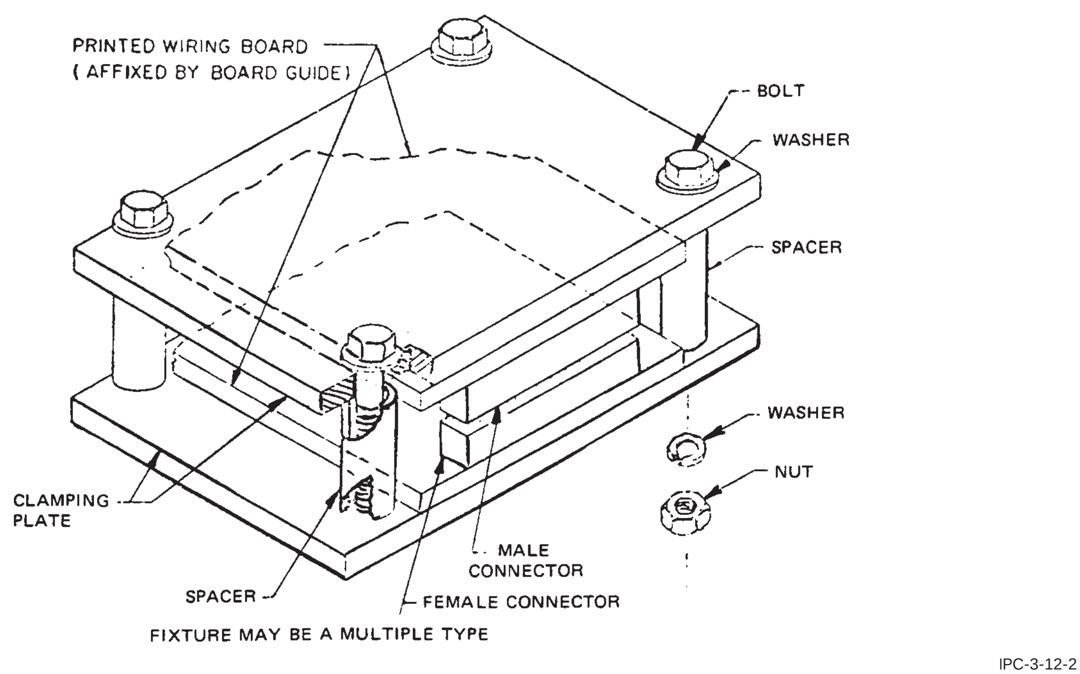


**Figure 2 Parallel Connector Fixture (Suggested)**

Table 1 and Figure 3 or 4 as specified in the individual connector specification; if no test is specified, Test Condition D shall apply.

**5.1.2** The fixtured test sample or a suitable dummy load shall be mounted on the vibration exciter during the calibration procedure. Any dummy load shall have the mass and center of gravity as that of the test sample and shall be fixtured in a similar manner (a reject connector provides an ideal dummy load).

**5.1.3** The control transducer shall be mounted on the test fixture immediately adjacent to the test specimen or dummy load. The displacement-acceleration curve of the sinusoidal input or the equalized random input shall fall within, the specified tolerances.

**5.2 Sinusoidal Vibration Test**

**5.2.1** The dummy load shall be replaced with the actual test sample.

**5.2.2** The test sample shall be connected to the discontinuity monitor and a minimum current of 100 milliamperes shall be established in the series circuit comprising all contacts of the test sample.

**5.2.3** The test sample shall be subjected to the sinusoidal test condition specified in the individual connector specification; the following details shall apply:

A. Amplitude — The test sample shall be subject to simple harmonic motion at an amplitude of 0.06 inch double amplitude (peak-to-peak displacement) or the maximum acceleration specified in Table 1, whichever is less.

B. Frequency Range — The vibration frequency shall be varied logarithmically between the approximate limits specified in Table 1; see 6.2 for alternate method.

C. Range Traverse Time and Duration — The entire frequency range shall be traversed in a time as specified in Table 1. The traverse (in either direction) shall be performed the indicated number of times along each of three (3) orthogonal axes for at least the indicated total vibration period per axis. If the procedure of Test Condition A is used for the 10 to 55Hz band of Test Conditions B, C or E, the duration of this portion shall be the same as the duration for this band using logarithmic cycling at the rate specified for Test Conditions B, C or E (approximately 1-1/3 hours along each of 3 orthogonal axes).

**5.3 Random Vibration Test**

**5.3.1** The dummy load shall be replaced with the actual test sample.

**5.3.2** The test sample shall be connected to the discontinuity monitor and a minimum current of 100 milliamperes shall be established in the series circuit comprising all contacts of the test sample.

**Table 1 Test Conditions**

| Test Condition | Peak Acceleration (Gravity Units) | Frequency Range | Approx. Traverse Time[1] | Traverses Per Axis | Duration Per Axis |
|---|---|---|---|---|---|
| A | 10 | 5 to 55 Hz | 0.5 min. | 240 | 2 hrs. |
| B | 10 | 10 to 500 Hz | 7.5 min. | 24 | 3 hrs |
| C | 15 | 10 to 2000 Hz | 10 min. | 24 | 4 hrs. |
| D[2/3] | 10 | 55 to 2000 Hz | 40 min. | 1 | 40 min. |
| E | 20 | 10 to 2000 Hz | 10 min. | 24 | 4 hrs. |
| F | 10.9[4] | 10 to 2000 Hz | N/A | N/A | 15 min. |

[1]Traverse time is that time to go from the lower frequency to the higher frequency, or vice versa.
[2]Test Condition D shall be preceded by vibration tests per Test Condition A.
[3]Test Condition D is intended to isolate resonant frequencies. If resonance is detected, the test sample shall be vibrated at each critical resonant frequency for 5 minutes; critical resonance is defined as a point on the test sample observed to have a maximum amplitude (or acceleration) more than twice that of the controlled input.
[4]Overall root-mean-square (RMS) acceleration.

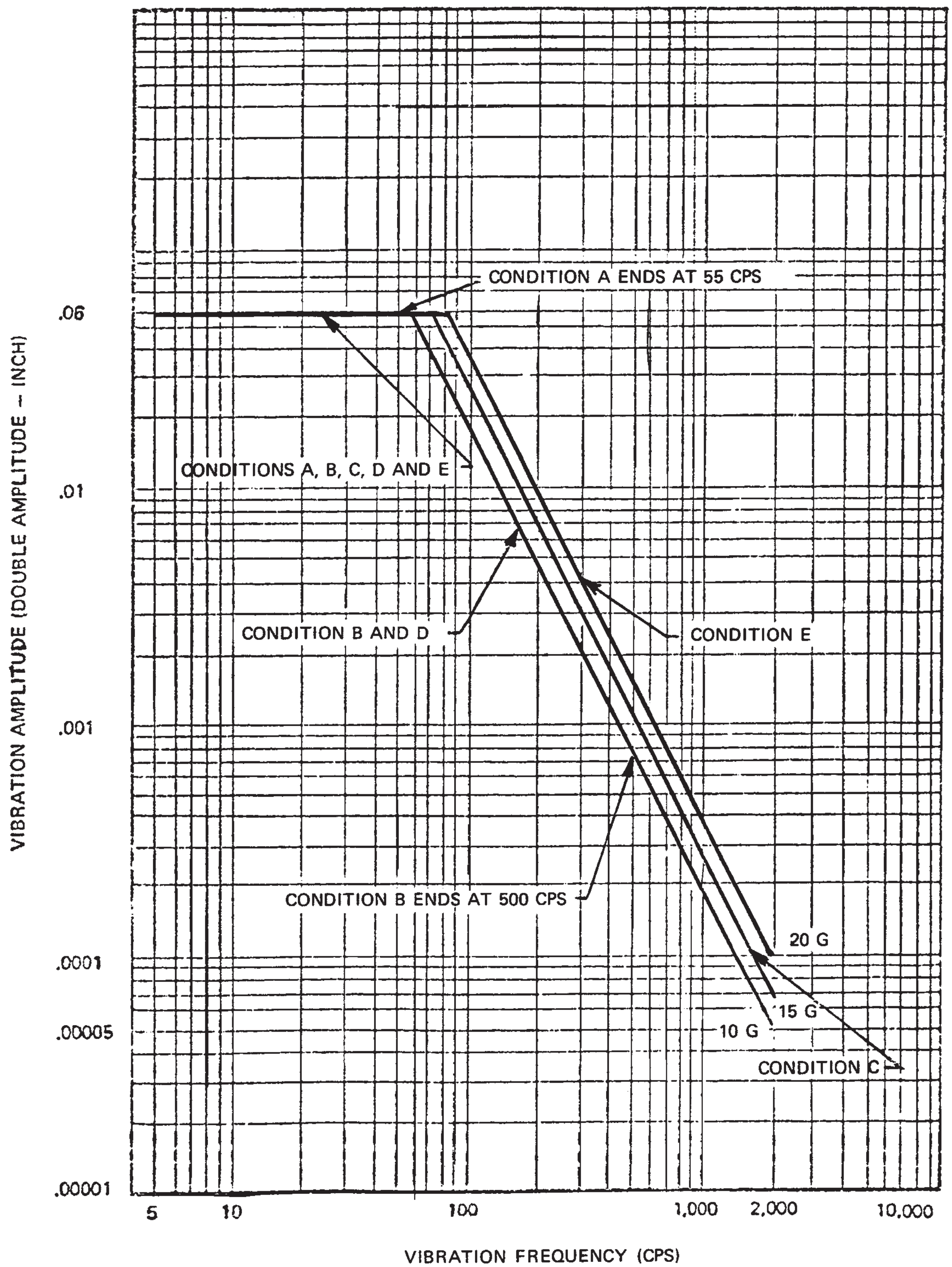


**Figure 3 Vibration Test Curves**

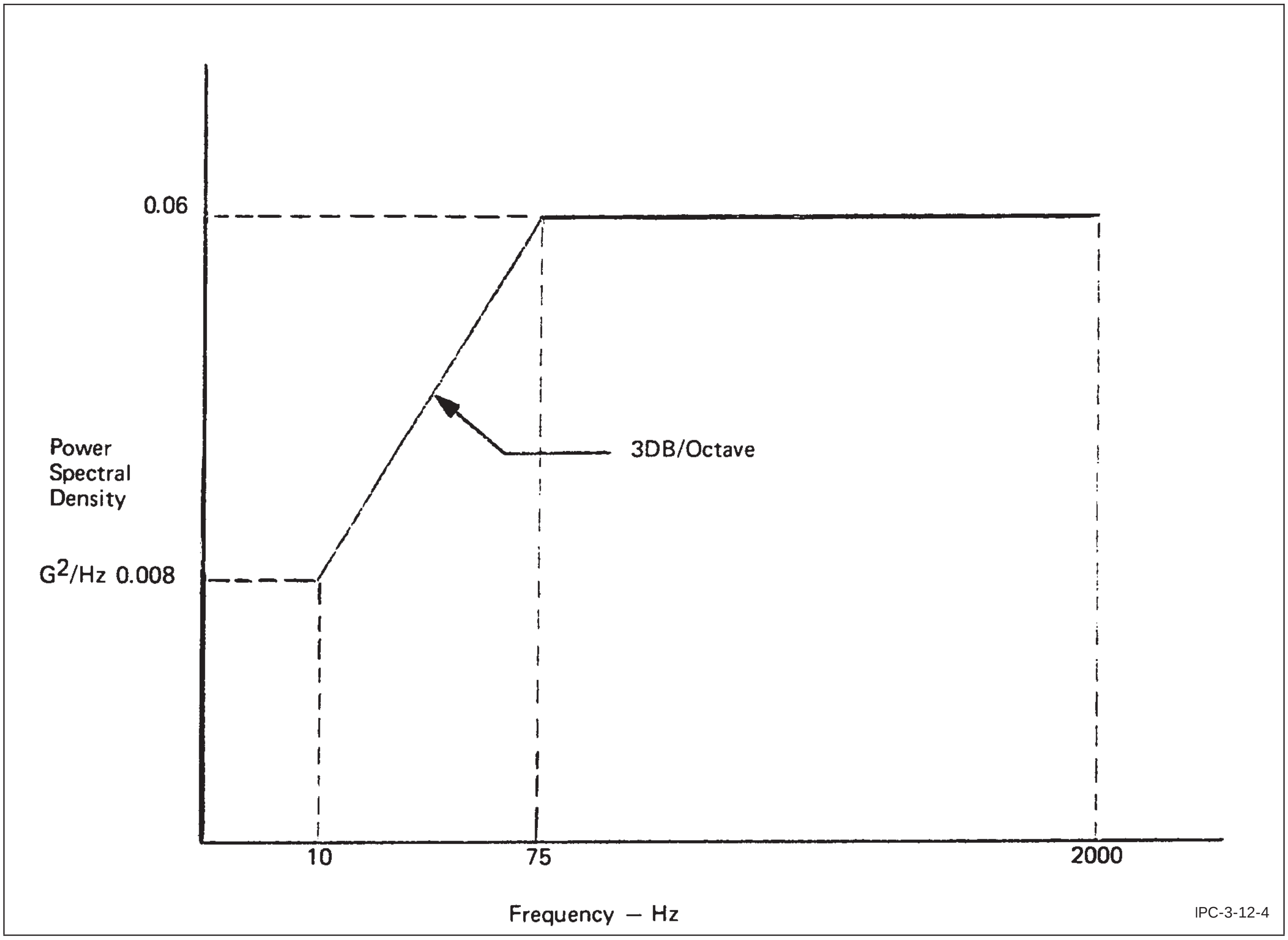


**Figure 4 Random Vibration Input**

**5.3.3** Resonant modes of the test sample shall be determined by varying the frequency of the applied sinusoidal vibration slowly through the frequency range from 55 to 2000 Hz at an amplitude of less than ± 2 G peak. The test sample shall be vibrated at a peak acceleration of ± 10G for 5 minutes at each critical resonant frequency observed (see Table 1, Note 3).

**5.3.4** The test sample shall be subjected to random vibration in accordance with Test Condition F, Table 1 and Figure 4.

**5.3.5** During the test along each axis, the contacts shall be continuously monitored for discontinuities in excess of 1 microsecond.

**6.0 *Notes***

**6.1** Acceptance criteria shall be established in terms of one, or any combination, of the following:

A. Loss of continuity during or after any imposed shock.

B. Mechanical damage.

C. Increase in contact resistance.

D. Decrease in contact normal force.

**6.2** A linear rate of change of frequency is permissible in place of the specified logarithmic rate 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 not be less than two.

B. The rate of change of frequency (Hz/min.) shall be constant for any one band.

C. The ratio of the rate of change of frequency of each band to the maximum frequency of that band shall be approximately the same as that ratio for every other band.

***EXAMPLE:*** 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 2000 Hz, in accordance with 6.2A. 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 2000k, respectively. The times, in minutes, to traverse the three frequency bands will therefore be, respectively,

$$\frac{125-55}{125k} \qquad \frac{500-125}{500k} \qquad \text{and } \frac{2000-500}{2000k}$$

***EXAMPLE:*** If the range traverse time is 30 minutes –

$$30 = \frac{70}{125k} + \frac{375}{500k} \pm \frac{1500}{2000k}$$

from which: k = 0.0687

The required maximum constant rates of frequency change for the three bands are therefore 8.55, 34.2 and 137 Hz/min., respectively, and the times of traverse of the bands are 8.2, 10.9 and 10.9 minutes, respectively.