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INTERNATIONAL
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# SURFACE VEHICLE RECOMMENDED PRACTICE

SAE J1765

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## SAE MINIATURE BULB VIBRATION TEST

***Foreword*—**This Document has not changed other than to put it into the new SAE Technical Standards Board Format.

***1. Scope*—**This SAE Recommended Practice was designed to be an accelerated vibration test that subjects bulbs to critical vibration/shock loading typically observed in normal vehicle service and can be employed for conformance of production (COP) testing. The test was designed for external vehicle applications.

***2. References***

**2.1 Applicable Publications—**The following publications form a part of the specification to the extent specified herein. Unless otherwise indicated the latest revision of SAE publications shall apply.

2.1.1 SAE PUBLICATIONS—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J573—Miniature Lamp Bulbs
SAE J759—Lighting Identification Code

**2.2 Related Publications—**The following publications are provided for information purposes only and are not a required part of this document.

2.2.1 SAE PUBLICATIONS—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J575—Tests for Motor Vehicle Lighting Devices and Components
SAE J1455—Joint SAE/TMC Recommended Environmental Practices for Electronic Equipment Design (Heavy-Duty Trucks)

2.2.2 FMVSS PUBLICATIONS—Available from the National Highway Traffic Safety Administration, 400 Seventh Street SW, Washington, DC 20024-0002.

FMVSS108—Lamps, Reflective Devices, and Associated Equipment (Available as 49 CFR 571.108)

2.2.3 IEC PUBLICATIONS—Available from American National Standards Institute, Inc., 11 West 42nd Street, New York, NY 10036.

IEC 810—Lamps for Road Vehicles—Performance Requirements





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## 3. *Definitions*

**3.1** **Power Spectral Density (PSD)—**The product of the real and imaginary Fourier coefficients of a signal divided by the frequency interval. The square root of the integral of PSD over all measured frequencies will yield the root-mean-square acceleration (Grms).

**3.2** **Wide Band Random—**Random vibration whose power spectral density has a relatively broad frequency range. All frequencies in the test range are excited simultaneously as opposed to the "narrow-band" where only a small portion of the frequencies in the test frequency range are excited at any one time.

**3.3** **Filament Mount Structure—**The filament mount structure consists of the filament, electrical lead wires, clamps or welds, and any filament or lead supports that comprise the active structure inside the bulb.

**3.4** **Closed-Loop Dynamic Vibration Equipment—**A laboratory test system consisting of an electromagnetic exciter (shaker), a feedback transducer (accelerometer), and a control unit with necessary power amplifiers capable of reproducing, within prescribed statistical limits, a predetermined vibration profile for the purpose of performing environmental stress screening. Figure 1.

**3.5** **Natural Frequency—**A vibration frequency of a mechanical system when the system is allowed to freely oscillate following an initial displacement. Real mechanical systems have numerous natural frequencies corresponding to distinct natural modes of vibration. Natural frequencies are inherent properties of a mechanical system, determined by the distribution of mass and stiffness of the system, and by boundary conditions imposed upon the system.

**3.6** **Resonant Frequency—**A frequency at which the ratio of the steady-state response amplitude (at the point of excitation) to harmonic excitation magnitude reaches a relative maximum. Resonant frequencies closely (but not necessarily exactly) coincide with natural frequencies.

Resonant frequencies are dependent upon the type and location of harmonic excitation (e.g., force, displacement, or velocity), as well as the mechanical properties and boundary conditions of the mechanical system. For example, displacement resonance and velocity resonance occur at different frequencies for any system with damping. (Ordinarily the difference is not significant.) A system will not exhibit a resonant frequency corresponding to a particular natural frequency if the point of excitation is at a node of the modeshape for the natural frequency; however, an antiresonance will be exhibited at that frequency (i.e., zero vibration amplitude at the point of excitation).

**3.7** **Grms—**The root-mean-square acceleration equivalent as a ratio with respect to gravity.

## 4. *Lighting Identification Codes, Markings, and Notices*

**4.1** Bulbs identified for use in vehicle exterior applications listed in SAE J759 (except H, HH, and HR headlamps) shall meet this document.

**5.** ***Test Procedure*—**See Figure 1.

**5.1** **Seasoning—**Bulbs are seasoned as specified in SAE J573 prior to being subjected to testing.

**5.2** **Voltage—**Test shall be conducted at the voltage specified in SAE J573 Section 2.2 or as specified by the manufacturer.

**5.3** **Test Equipment—**The test equipment shall be closed-loop dynamic vibration equipment and controller (or equivalent) capable of vibrating in random modes, produce variable vibration from 10 to 2000 Hz with a tolerance of ±4 dB and a minimum of 500 pounds force.

**5.4** **Test Fixture Mounting—**The bulb shall be fastened rigidly to a fixture on the vibration table. This may be achieved by clamping, soldering, or embedding. Electrical connections shall be made such that the connection is assured during the whole test.

Fixtures shall be designed such that their natural frequencies (fully loaded or unloaded) do not occur below 1200 Hz.

**5.5** **Control Point—**Attach the transducer used to measure and maintain the specified vibration characteristics at a control point location as close to the test bulb as possible on the test fixture without interfering with the bulb resonance frequencies.

**5.6** **Axis of Vibration—**With the filament mounting structure horizontal, a direction of excitation normal to the filament(s) axis is used for testing.

**5.7** **Test Conditions—**The test shall last for a period of 6 h total. This is to include periods of 2 h unlighted, then 2 h lighted, then 2 h unlighted again.

a. Vibration—Wide Band Random
b. Duration—2 h Cold (Unlighted)
2 h (Lighted)
2 h Cold
6 Total
c. Frequency Range—50 to 1000 Hz
d. Acceleration Levels—0.08 $g^2$/Hz (50 to 400 Hz)
0.0025 $g^2$/Hz (600 to 1000 Hz)
e. Total Grms—5.75

## *6. Requirements*

**6.1** Upon completion of the 6-h test specified in Section 5, bulb shall be functional and meet the requirements of SAE J573 or as specified by the manufacturer.

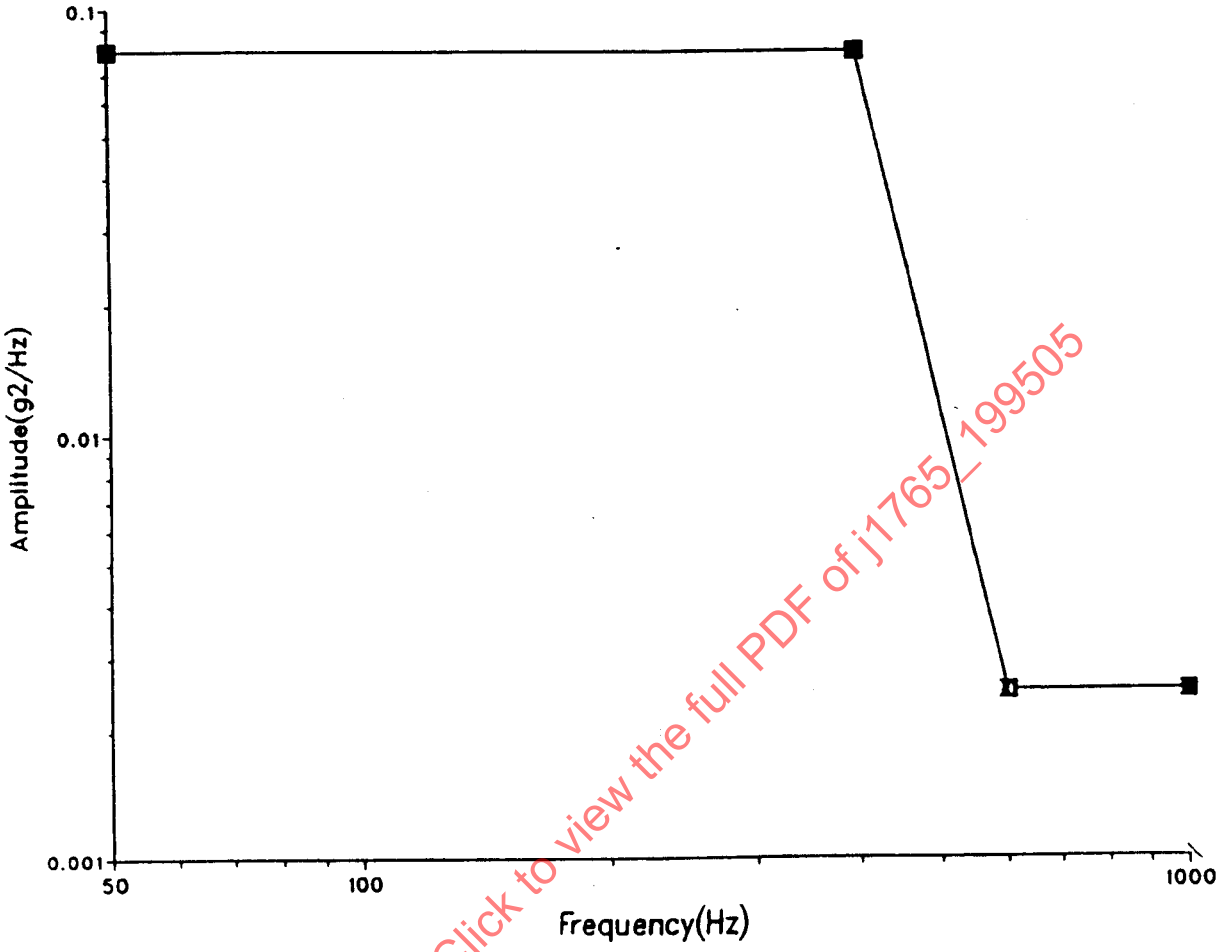


FIGURE 1—SAE RANDOM VIBRATION TEST PROFILE



PREPARED BY THE SAE ROAD ILLUMINATION DEVICES STANDARDS, TEST METHODS, AND EQUIPMENT COMMITTEE AND APPROVED BY THE SAE LIGHTING COORDINATING COMMITTEE

**Rationale—**The changes are as follows:

**1. Scope**—Measurement of vibration and shock characteristics in service reveal frequencies of up to 20 000 Hz. The power spectral density (PSD) levels at frequencies above 1000 Hz, however, are so low as to be insignificant. The resonant frequencies of the critical construction features of most vehicle bulbs fall within the range of 200 to 800 Hz. This fact together with problems in the design of holders suitable for operation at frequencies above this level has led to the adoption of 1000 Hz as the maximum limit for the test schedule (Similar to International Electrotechnical Commission, IEC 810).

Low wattage miniature bulb filament resonant frequencies generally occur between 200 to 600 Hz. Furthermore, manufacturers data suggest that 2 to 6 Grms is an acceptable "extreme" test level to be used for bulb testing.

For years, industry employed the Michigan drum test for design and Conformance of Production (COP). Repeatability was always an issue. We therefore turned to the computer controlled Electromagnetic shake table to provide a reproducible short-term test. The objective was to develop a repeatable, short-term COP test. The need for an accelerated test resulted in the differences between the IEC 810 and this vibration test.

**2. References**—None required/prepared.

**2.1 Applicable Documents**—None required/prepared.

**3. Definitions**—None required/prepared.

**4. Lighting Identification Codes**—None required/prepared.

**5. Test Conditions**—This standard differs from IEC 810 in two major areas; test range and band width. Existing data suggests that low level vibrations between 12 and 50 Hz are not "the" significant cause of typical field filament and bulb failure modes. A large portion of the "Grms" in the IEC specified range come from these low frequencies. 50 Hz is a more realistic starting point. Secondly, narrow band testing does not adequately excite all bulb components that may interact in field applications. Therefore, wide band random is required for the test to correlate with field conditions. The IEC has proposed accepting wide band random as an alternative.

**5.1 "Seasoning**—None required/prepared.

**5.2 Voltage**—None required/prepared.

**5.3 Test Equipment**—None required/prepared.

**5.4 Test Fixture Mounting**—None required/prepared.

**5.5 Control Point**—The location of a transducer used to measure and maintain the specified vibration characteristics.

**5.6 Axis of Vibration**—As noted in IEC 810, "Field measurements on vehicles have shown that vehicle bulbs are usually subjected to greater stresses in the vertical plan than in either of the horizontal planes. It is therefore recommended that a vertical direction of excitation is used for testing with the principal axis of the bulb lamp and filament(s) horizontal."

**5.7 Acceleration Levels**—Grms can be calculated from the area under the curve. For flat PSD curves, the formula is simply: