ANSI S2.71-1983 (R 2006)
(Formerly ANSI S3.29-1983)

AMERICAN NATIONAL STANDARD

Guide to the Evaluation of Human Exposure to Vibration in Buildings

ANSI S2.71-1983
(Formerly ANSI S3.29-1983)

Accredited Standards Committee S2, Mechanical Vibration and Shock

Standards Secretariat
Acoustical Society of America
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Secretariat

Acoustical Society of America

Approved by American National Standards Institute, Inc.

4 April 1983

ABSTRACT

Reactions of humans to vibrations of 1 to 80 Hz inside buildings are assessed in this Standard by use of degrees of perception and associated vibration levels and durations. Accelerations or velocities inside buildings may be measured to assess perceptibility and possible adverse reactions from those inside. A variety of building types and situations are covered by the use of multiplying factors applied to the basic curves. Responses are related to the event durations, frequencies of vibration, and body orientation with respect to the vibration. Adherence to the vibration magnitudes corresponding to the perceptibility threshold will insure minimum discomfort and annoyance. The "acceptability" of a given magnitude of vibration above the perception threshold will be influenced by the interference of the vibrations in the activities of individuals and by the various social, economic, and legal relationships between the source of the vibrations and the receivers. Other related factors are the degree of startle, fear of injury or structural damage, and attitudes about the source including its inevitability, duration, and necessity.

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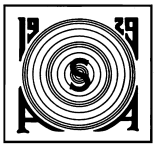

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Foreword

[*This Foreword is not a part of ANSI S2.71-1983 (R 2006) American National Standard Guide to the Evaluation of Human Exposure to Vibration in Buildings (formerly ANSI S3.29-1983).*]

This American National Standard Guide to the Evaluation of Human Exposure to Vibration in Buildings was developed under the American National Standard Committee method of procedure under the secretariat of the Acoustical Society of America.

This American National Standard was developed and approved in 1983 by the Accredited Standards Committee on Bioacoustics S3, which had the following scope at that time:

> *Standards, specifications, methods of measurement and test, and terminology in the fields of psychological and physiological acoustics, including aspects of general acoustics, shock and vibration which pertain to biological safety, tolerance, and comfort.*

In 2004, work related to human exposure to mechanical vibration and shock was transferred to Accredited Standards Committee S2, Mechanical Vibration and Shock. Five approved S3 standards were transferred to S2 at that time and will be redesignated and republished as they each come up for reaffirmation in the normal standards cycle. This redesignation of ANSI S3.29-1983 (R2001) is taking place under this process.

No substantive changes have been made to the approved 1983 text with the exception of correcting errors in Table 1 that were identified in an erratum published in 1998. The current document has also been reformatted to conform to the Sixth Edition of the ASA Committee on Standards Editorial (ASACOS) *Rules for Preparation of American National Standards in Acoustics, Mechanical Vibration and Shock, Bioacoustics, and Noise* (2003), including substitution of the term Annex for the term Appendix throughout.

At the time this standard was submitted to Standards Committee S3 for approval, the membership was as follows:

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Working Group S3-39(S2) on Vibration Levels, responsible for assisting the committee in drafting this standard, had the following membership:

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Suggestions for improvements in this standard will be welcomed. They should be sent to the Standards Secretariat, Acoustical Society of America, 35 Pinelawn Road, Suite 114E, Melville, NY 11747.

Introduction

Vibration in buildings can interfere with activities and affect human occupants in many ways. The quality of life can be reduced as also can working efficiency. This standard provides recommendations on the magnitudes of vibration which are perceptible and regarded as tolerable by building occupants under different circumstances, in the frequency range 1-80 Hz.

There are many and complex factors determining human response to vibration, and a paucity of consistent quantitative data concerning man's perception of vibration and his reaction to it. This standard has been prepared to facilitate the evaluation and comparison of data gained from continuing research in this field, and to give provisional recommendations on satisfactory magnitudes with respect to human response to vibration in buildings. The vibration magnitudes proposed in this standard are a compromise between the available data and the need for recommendations which are simple and suitable for general application. These vibration magnitudes are defined explicitly in numerical terms to avoid ambiguity and to encourage precise measurement in practice. However, users of these recommendations should bear in mind the restrictions placed upon their application.

Because of the wide variety of possible conditions and effects of human exposure to vibration, and the existing shortage of applicable data, more detailed guidance than contained in this standard is not warranted at the present time. Nevertheless, this standard not only should prove useful in the assessment of existing or predicted vibration environments but also should stimulate the reporting and critical evaluation of new findings about man's reaction to vibration in buildings. There are basically two kinds of vibration that affect people in buildings, namely:

(1) Vibration transmitted to the human body as a whole through the supporting surface: through the feet when standing, the buttocks when seated, or the supporting area when reclining.

(2) Vibrations of the building and the resulting reactions of the occupants. This second kind of exposure results from the gross structure vibration (whole-structure deformation), floor vibration (primarily vertical motion), and wall vibrations (primarily horizontal motions producing secondary noises or rattlings). Resulting reactions are typically fear of damage to the structure or its contents, startle, and interference with sleep, conversation, or other activities.

This standard applies mainly to the vibrations described in (2) above, and in particular to the vibration, rattling, and annoyance effects produced when a building responds to a vibration source. The general case of human response to vibration as described in (1) above, is covered by ANSI S3.18-1979, "Guide for the Evaluation of Human Exposure to Whole Body Vibrations," which recommends vibration magnitudes corresponding to task proficiency, human comfort, health, and safety.

American National Standard

Guide to the Evaluation of Human Exposure to Vibration in Buildings

1 Scope and field of application

This standard defines measurement methods for vibration that affects humans within buildings and the magnitudes of vibration at which humans will perceive and possibly react when inside the buildings. Application of this standard requires consideration of the following factors:

(1) Type of excitation: steady state, intermittent, and impulsive vibration.

(2) Frequency and direction of the vibration (1 to 80 Hz and three directions of motion).

(3) Use made of the occupied space in the building; for example, workshop, office, residential, hospital operation room, or other critical areas.

(4) Time of day.

(5) Vibration acceptability. Acceptable limits of vibration cannot be specified rigidly, and depend on specific circumstances. However, in the frequency range of 1 to 80 Hz, this standard gives guidance on the magnitude of vibration at which adverse human reactions begin to occur. In cases where sensitive equipment or delicate operations impose more stringent criteria than human comfort, the more stringent values should be applied.

(6) The vibration magnitudes recommended in this standard were established with respect to human response. They are not to be confused with those required to produce structural damage to the building itself.

2 References

S1.6-1967 (R1971), Preferred Frequencies and Band Numbers for Acoustical Measurements (Agrees with ISO R266).

S1.11-1966 (R1971), Octave, Half-Octave, and Third-Octave Band Filter Sets, Specifications for (IEC 225).

S2.2-1959 (R1971), Calibration of Shock and Vibration Pickups, Methods for the.

S2.4-1960 (R1971), Specifying the Characteristics of Auxiliary Equipment for Shock and Vibration Measurements, Method for.

S2.11-1969 (R1973), Calibrations and Tests for Electrical Transducers used for Measuring Shock and Vibration, Selection of.

S3.18-1979, Guide for the Evaluation of Human Exposure to Whole-Body Vibration.