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**(Revision of ANSI S3.34-1986)**

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## AMERICAN NATIONAL STANDARD

# Guide for the Measurement and Evaluation of Human Exposure to Vibration Transmitted to the Hand

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ANSI S2.70-2006  
(Revision of ANSI S3.34-1986)

Accredited Standards Committee S2, Mechanical Vibration and Shock

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Standards Secretariat  
Acoustical Society of America  
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**Guide for the Measurement and Evaluation of  
Human Exposure to Vibration  
Transmitted to the Hand**

**Secretariat**

**Acoustical Society of America**

**Approved 19 May 2006**

**American National Standards Institute, Inc.**

**Abstract**

This standard specifies the recommended method for the measurement, data analysis, vibration and health risk assessments, and reporting of human exposure to hand-transmitted vibration. A standard format is established for measurement, data analysis, vibration and health risk assessments, and reporting of hand-transmitted vibration, periodic or random, in three orthogonal axes, in the frequency range from 5.6 Hz to 1,400 Hz. Three normative annexes provide guidance for vibration and health risk assessments, mitigating health risks, training, and medical surveillance related to hand-transmitted vibration.

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## Foreword

[This Foreword is for information only and is not a part of the American National Standard ANSI S2.70-2006 American National Standard Guide for the Measurement and Evaluation of Human Exposure to Vibration Transmitted to the Hand.]

This standard comprises a part of a group of definitions, standards, and specifications for use in mechanical vibration and shock. It was developed and approved by Accredited Standards Committee S2, Mechanical Vibration and Shock, under its approved operating procedures. Those procedures have been accredited by the American National Standards Institute (ANSI). The Scope of Accredited Standards Committee S2 is as follows:

*Standards, specifications, methods of measurement and test, and terminology in the field of mechanical vibration and shock and condition monitoring and diagnostics of machines, including the effects of exposure to mechanical vibration and shock on humans, including those aspects which pertain to biological safety, tolerance, and comfort.*

This standard is a revision of ANSI S3.34-1986 (R 1997), which has been technically revised. The revisions incorporated into this standard make the measurement and data analysis procedures of the standard compatible with the corresponding procedures specified in ISO 5349 – Part 1 and ISO 5349 – Part 2. Vibration and health risks assessment procedures, methods for mitigating the potential for workers developing symptoms related to hand-arm vibration syndrome (HAVS), and training and medical surveillance guidelines have been added to this standard.

This standard is not comparable to any existing ISO Standard.

At the time this Standard was submitted to Accredited Standards Committee S2, Mechanical Vibration and Shock, for approval, the membership was as follows:

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Suggestions for improvements of this standard will be welcomed. They should be sent to Accredited Standards Committee S2, Mechanical Vibration and Shock, in care of the Standards Secretariat of the Acoustical Society of America, 35 Pinelawn Road, Suite 114E, Melville, New York 11747-3177. Telephone: 631-390-0215; FAX: 631-390-0217; E-mail: [asastds@aip.org](mailto:asastds@aip.org)

## Introduction

Intense vibration can be transmitted from hand-held percussive or vibrating devices, tools, and work pieces to the hands and arms of the user. Such situations occur when a person uses pneumatically, hydraulically, and electrically powered percussive tools (i.e., chipping hammers, needle scalars, impact wrenches, etc.); pneumatically, hydraulically, and electrically powered grinders and sanders; gasoline powered tools (i.e., chain saws, circular saws, edge trimmers, etc.); and pedestal grinders. These vibrations are usually transmitted through the hand to the arm and shoulder. Depending on individual work practices and work situations, this vibration can be transmitted to one hand only or to both hands simultaneously. Continued habitual use of some types of hand-held vibrating devices, tools, and work pieces has been found under certain circumstances to be associated with patterns of diseases affecting the hand and arm. The patterns of various symptoms observed have been called vibration disease, vibration syndrome, vibration white finger (VWF), or Raynaud's phenomenon of occupational origin. These disorders have been grouped into a single syndrome referred to as the hand-arm vibration syndrome (HAVS). Hand-arm vibration may also cause entrapment syndromes, such as carpal tunnel syndrome, as well as other upper extremity cumulative trauma disorders (CTDs). For the purpose of this standard, hand-transmitted vibration is defined as *the mechanical vibration that, when transmitted to the human hand-arm system, may entail risks to worker health and safety, in particular vascular, bone or joint, neurological, and muscular.*

The International Organization for Standardization (ISO) has developed two international standards: (1) ISO 5349 – Part 1 and (2) ISO 5349 – Part 2. The appendices in ISO 5349 – Part 1 give specific guidance on the health effects related to hand-transmitted vibration, the relationship between vibration exposure and effects on health, factors likely to influence the effects of human exposure to hand-transmitted vibration in working conditions, and preventative measures to be adopted to reduce the potential for developing symptoms related to HAVS. ISO 5349 – Part 2 gives specific guidelines on how to make vibration measurements on hand-held vibrating and percussive tools. The user of this standard is, therefore, directed to these ISO standards for specific guidance in these areas.

The Parliament of the European Union has issued the European Union Human Vibration Directive-2002/44/EC. This directive specifies vibration daily exposure action values (DEAV) of  $2.5 \text{ m/s}^2$  and daily exposure limit values (DELV) of  $5.0 \text{ m/s}^2$  that, when achieved, will reduce the potential for users of hand-held vibrating and percussive devices, tools, and work pieces to develop symptoms related to HAVS. The DEAV and DELV specified in the EU human vibration directive have generally been accepted by medical experts, scientists, and engineers in governmental agencies, research institutions, and industry in the USA and other countries.

The guidance provided in this standard and its annexes are intended to assist in reducing the potential for the occurrences of HAVS and other related hand-arm vibration disorders among persons who work with hand-held vibrating and percussive devices, tools and work pieces. Many factors affect the potential for an individual to develop symptoms related to HAVS. Because the subjective symptoms and objective clinical findings associated with HAVS are similar to the pathology arising from other causes, it is imperative that a proper differential diagnosis be performed on workers who display pathology related to HAVS by a physician with qualifications and experience in differential diagnosis of hand-arm syndromes and diseases.

## American National Standard

# Guide for the Measurement and Evaluation of Human Exposure to Vibration Transmitted to the Hand

## 1 Scope

**1.1** This standard specifies the recommended method for the measurement, data analysis and evaluation, vibration and health risk assessments, and reporting of hand-transmitted vibration exposure. The methods specified in this standard are to be used to characterize and evaluate vibration impinging on the hands of humans and to give guidance on assessing the potential for this vibration to result in pathology related to hand-arm vibration exposure among the users of hand-held percussive or vibrating devices, tools, and work pieces. Factors, such as grip and push forces applied to tool handles, orientation of the hands and tool relative to a specific work piece, and intermittency of vibration exposure that can affect one's exposure to hand-transmitted vibration are not addressed in this standard.

**1.2** Prolonged excessive exposure to hand-transmitted vibration may result in adverse health effect, such as hand-arm vibration syndrome (HAVS) and other conditions of the upper extremities, such as carpal tunnel syndrome. For the purpose of this standard, hand-arm vibration syndrome is defined as *the complex of peripheral vascular, neurological, and musculoskeletal disorders of the hand and arm that are associated with industrial exposure to hand-transmitted vibration.*

**1.3** This standard is intended as a guide for the measurement, data analysis and evaluation, vibration and health risk assessments, and reporting of human exposure to vibration transmitted to the hands, with a view toward reducing the potential for the occurrence of pathology related to hand-arm vibration exposure among the users of hand-held percussive or vibrating devices, tools, and work pieces.

**1.4** The methods of measurement, data analysis, evaluation, assessments, and reporting apply to periodic or random hand-transmitted vibration in three mutually orthogonal axes in the frequency range from 5.6 Hz to 1,400 Hz. The information presented in this standard applies only to vibration exposure from hand-held devices, tools, and work pieces used in industrial work processes that involve the use of hand-held devices, tools, and work pieces.

## 2 Normative references

The following referenced documents are indispensable for the application of this standard. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ANSI S1.11 *American National Standard Octave, Half-Octave, and Third-Octave Band Filter Sets.*

ANSI S2.1/ISO 2041 *American National Standard Vibration and Shock—Vocabulary.*

ISO 5349-1 *Mechanical Vibration – Measurement and Evaluation of Human Exposure to Hand-Transmitted Vibration – Part 1: General Requirements.*