Australian Standard®

Mechanical vibration—Measurement and evaluation of human exposure to hand-transmitted vibration

Part 1: General requirements

This Australian Standard® was prepared by Committee AV-010, Vibration and Shock Human Effects. It was approved on behalf of the Council of Standards Australia on 24 May 2013. This Standard was published on 13 June 2013.

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- Association of Australian Acoustical Consultants
- Australasian Railway Association
- Australian Acoustical Society
- Australian Chamber of Commerce and Industry
- Australian Industry Group
- Australian Institute of Occupational Hygienists
- Department of Defence
- Hire and Rental Industry Association of Australia
- Human Factors and Ergonomics Society of Australia
- NSW Department of Trade and Investment, Regional Infrastructure and Services
- Safe Work Australia
- University of Wollongong

This Standard was issued in draft form for comment as DR AS ISO 5349.1.

Standards Australia wishes to acknowledge the participation of the expert individuals that contributed to the development of this Standard through their representation on the Committee and through the public comment period.

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Part 1: General requirements

Originated as part of AS 2763—1985.
Previous edition part of AS 2763—1988.
Revised in part and redesignated as AS ISO 5349.1—2013.

Published by SAI Global Limited under licence from Standards Australia Limited, GPO Box 476, Sydney, NSW 2001, Australia

ISBN 978 1 74342 499 5

PREFACE

This Standard was prepared by the Standards Australia Committee AV-010, Vibration and Shock Human Effects, to supersede (in part) AS 2763—1988, *Vibration and shock—Hand-transmitted vibration—Guidelines for measurement and assessment of human exposure*.

The objective of this Standard is to prescribe procedures for the measurement and assessment of vibration in the workplace that are in keeping with the current best practice.

This Standard is identical with, and has been reproduced from ISO 5349-1:2001, *Mechanical vibration—Measurement and evaluation of human exposure to hand-transmitted vibration*, Part 1: *General requirements.*

As this Standard is reproduced from an International Standard, the following applies:

(a) In the source text 'this part of ISO 5349' should read 'this Australian Standard'.

(b) A full point substitutes for a comma when referring to a decimal marker.

References to International Standards should be replaced by references to Australian or Australian/New Zealand Standards, as follows:

Reference to International Standard		*Australian/New Zealand Standard*	
ISO		AS ISO	
5349	Mechanical vibration—Measurement and evaluation of human exposure to hand-transmitted vibration	5349	Mechanical vibration—Measurement and evaluation of human exposure to hand-transmitted vibration
5349-2	Part 2: Practical guidance for measurement at the workplace	5349.2	Part 2: Practical guidance for measurement at the workplace

The terms 'normative' and 'informative' have been used in this Standard to define the application of the annex to which they apply. A 'normative' annex is an integral part of a Standard, whereas an 'informative' annex is only for information and guidance.

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FOREWORD

This first edition of ISO 5349-1 cancels and replaces ISO 5349:1986, of which it constitutes a technical revision. It is, in most respects, compatible with its predecessor, but differs from it technically in several important respects.

In the previous version, the evaluation of vibration exposure was based on the directional component with the greatest frequency-weighted root-mean-square acceleration. In the present version, the evaluation is based on the "vibration total value", i.e. the root-sum-of-squares of the three frequency-weighted root-mean-square component values. This change recognizes the fact that the vibration characteristics of some power tool types are not dominated by a single directional component.

Vibration exposures based on the root-sum-of-squares method will have values greater than those reported for a single direction of vibration. Measurement of vibration in three axes will result in a vibration total value of up to 1,7 times (typically between 1,2 and 1,5 times) the magnitude of the greatest component. For data obtained in accordance with ISO 5349:1986, the vibration total value can be calculated from the three component values as shown in 4.5 of this part of ISO 5349. Where only the greatest single-axis value is available, the vibration total value shall be estimated from this value using a suitable multiplying factor as discussed in 4.5.

The daily vibration exposure in accordance with this part of ISO 5349 is based on the 8-h energy-equivalent acceleration value. The previous version used a reference duration of 4 h. The change to the more conventional 8-h reference duration brings the evaluation of vibration exposure into line with the "time-weighted average" procedures commonly used for the evaluation of human exposures to noise and to chemical substances. The use of the 8-h reference duration is purely a matter of convention and does not imply that a "typical" daily exposure duration is 8 h. Conversion of 4-h equivalent magnitudes to 8-h values is achieved easily, by applying a multiplying factor of 0,7.

The frequency weighting previously had a slope of zero at frequencies below 16 Hz and –6 dB per octave at higher frequencies and applied over the frequency range covered by the octave bands from 8 Hz to 1 000 Hz. It is now defined mathematically in annex A as a realizable filter characteristic, designated W_{h}. Band-limiting filters are also defined with cut-off frequencies of 6,3 Hz and 1 250 Hz. The one-third-octave band weighting factors, also given in annex A, differ slightly from those in the previous version in that they describe the W_{h} curve with band-limiting included.

The guidance in annex C on the relationship between vibration exposure and the development of vascular symptoms, is broadly compatible with that in annex A of the previous version, but is restricted to consideration of a prevalence of 10 % in order to limit the potential for inappropriate use of the relationship. Compared to the previous version, daily vibration exposures are now expressed as 8-h energy-equivalent values and the values quoted have been multiplied by a factor of 1,4 to estimate the increase resulting from the change from evaluation using the greatest single-axis value to evaluation using the vibration total value.

INTRODUCTION

Intensive vibration can be transmitted to the hands and arms of operators from vibrating tools, vibrating machinery or vibrating workpieces. Such situations occur, for example, when a person handles tools such as pneumatic, electric, hydraulic or internal combustion engine-driven chain saws, percussive tools or grinders.

Depending on the type and place of work, vibration can enter one arm only, or both arms simultaneously, and may be transmitted through the hand and arm to the shoulder. The vibration of body parts and the perceived vibration are frequently a source of discomfort and possibly reduced proficiency. Continued, habitual use of many vibrating power tools has been found to be connected with various patterns of diseases affecting the blood vessels, nerves, bones, joints, muscles or connective tissues of the hand and forearm.

The vibration exposures required to cause these disorders are not known precisely, neither with respect to vibration magnitude and frequency spectrum, nor with respect to daily and cumulative exposure duration. The guidance given in this part of ISO 5349 is derived from limited quantitative data available from both practical experience and laboratory experimentation concerning human response to hand-transmitted vibration, and on limited information regarding current exposure conditions. It is thus difficult to propose a comprehensive method for the evaluation of vibration exposure. However, the use of the information given in this part of ISO 5349 should protect the majority of workers against serious health impairment associated with hand-transmitted vibration. It may also assist in the development of new hand-operated power tools to reduce the risk of vibration-related health effects. It does not define safe exposure ranges in which vibration diseases cannot occur.

The use of this part of ISO 5349 will contribute to the gathering of consistent data in order to improve occupational safety. In particular, it is hoped that such data will serve to extend the present knowledge of dose-effect relationships.

This part of ISO 5349 specifies the general requirements for the measurement and evaluation of human exposure to hand-transmitted vibration. It is supplemented by the information given in ISO 5349-2, which gives practical guidance for the implementation of appropriate measurement and evaluation techniques at the workplace. Instrumentation to be used for measurements made in accordance with ISO 5349 is fully specified in ISO 8041.

Annex A contains definitions for the frequency weighting W_h and for band-limiting filters, required for measurement of frequency-weighted acceleration in accordance with ISO 5349.

Annex B contains information on the health effects of hand-transmitted vibration, while annex C gives guidance which may assist competent authorities responsible for the definition of exposure limits or action levels as required. Annex D contains information on other factors which can affect human response to hand-transmitted vibration and annex E contains guidance on preventive measures for those responsible for occupational health and safety.

To facilitate further progress in this field and to allow the quantitative comparison of exposure data, uniform methods for measuring and reporting exposure of human beings to hand-transmitted vibration are desirable. Further information is contained in annex F.

AUSTRALIAN STANDARD

Mechanical vibration—Measurement and evaluation of human exposure to hand-transmitted vibration

Part 1:
General requirements

1 Scope

This part of ISO 5349 specifies general requirements for measuring and reporting hand-transmitted vibration exposure in three orthogonal axes. It defines a frequency weighting and band-limiting filters to allow uniform comparison of measurements. The values obtained can be used to predict adverse effects of hand-transmitted vibration over the frequency range covered by the octave bands from 8 Hz to 1 000 Hz.

This part of ISO 5349 is applicable to periodic and to random or non-periodic vibration. Provisionally, this part of ISO 5349 is also applicable to repeated shock type excitation (impact).

NOTE 1 The time dependency for human response to repeated shocks is not fully known. Application of this part of ISO 5349 for such vibration is to be made with caution.

This part of ISO 5349 provides guidance for the evaluation of hand-transmitted vibration exposure, specified in terms of a frequency-weighted vibration acceleration and daily exposure time. It does not define limits of safe vibration exposure.

NOTE 2 Annex C is concerned with the approximate relative importance of various characteristics of the vibration exposure which are believed to produce health effects.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 5349. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 5349 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 2041, *Vibration and shock — Vocabulary.*

ISO 5349-2, *Mechanical vibration — Measurement and evaluation of human exposure to hand-transmitted vibration — Part 2: Practical guidance for measurement at the workplace.*

ISO 8041, *Human response to vibration — Measuring instrumentation.*

IEC 61260, *Electroacoustics — Octave-band and fractional-octave-band filters.*