

Australian Standard<sup>®</sup>

**Evaluation of human exposure to whole-body vibration**

**Part : General requirements**



This Australian Standard® was prepared by Committee AV-010, Mechanical Vibration and Shock Human Effects. It was approved on behalf of the Council of Standards Australia on 30 September 2001.

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The following are represented on Committee AV-010:

- Association of Australian Acoustical Consultants
  - Australasian Railway Association
  - Australian Chamber of Commerce and Industry
  - CSIRO—Division of Telecommunications and Industrial Physics
  - Department of Mineral Resources NSW
  - Federal Chamber of Automotive Industries
  - National Occupational Health & Safety Commission
  - Royal Institution of Naval Architects
  - University of Newcastle
  - WorkCover New South Wales
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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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Australian Standard<sup>®</sup>

## Evaluation of human exposure to whole-body vibration

### Part : General requirements

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## PREFACE

This Standard was prepared by the Standards Australia Committee AV-010, Mechanical vibration and Shock Human Effects to supersede—

AS

2670 Evaluation of human exposure to whole-body vibration

2670.1—1990 Part 1: General requirements

2670.3—1990 Part 3: Evaluation of exposure to whole-body Z-axis vertical vibration in the frequency range 0.1 to 0.63 Hz

*This Standard incorporates Amendment No. 1 (June 2013). The changes required by the Amendment are indicated in the text by a marginal bar and amendment number against the clause, note, table, figure or part thereof affected.*

The objective of this Standard is to provide designers, operators and relevant authorities with methods for the measurement of periodic, random and transient vibration transmitted to the human body as a whole from the supporting surfaces and to provide guidance on the possible effects of the vibration on health, comfort and perception and motion sickness.

This Standard is one of a series dealing with the evaluation of human exposure to whole-body vibration, the series being arranged as follows:

Part 1: General requirements (this Standard)

Part 2: Continuous and shock-induced vibration in buildings (1 to 80 Hz)

Part 4: Guidelines for the evaluation of the effects of vibration and rotational motion on passenger and crew comfort in fixed-guideway transport systems

This edition incorporates new experience and research results reported in the literature which made it desirable to—

- (a) reorganize the Parts of the series;
- (b) change the method of measurement and analysis of the vibration environment; and
- (c) change the approach to the application of the results.

This Standard is identical with and has been reproduced from ISO 2631-1:1997, *Mechanical vibration and shock—Evaluation of human exposure to whole-body vibration, Part 1: General requirements*, and its Amendment 1 (2010), which has been added at the end of the document.

A1

**‘text deleted’**

The term ‘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.

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

- (i) Its number appears on the cover and title page while the International Standard number appears only on the cover.
- (ii) In the source text, ‘this part of ISO 2631’ should read ‘this Australian Standard’.
- (iii) A full point substitutes for a comma when referring to decimal mark.

None of the documents referenced in this Standard has been adopted as an Australian Standard.

A1

Of the Standards referenced in this document, ISO 2041:1990, ISO 5805:1997 and ISO 8041:1990 have not been adopted as Australian Standards. IEC 61260:1995 has been adopted as AS/NZS 4476:1997, *Acoustics—Octave-band and fractional-octave-band filters*, but it does not include amendments from IEC 61260:2001 and subsequent to that.

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## FOREWORD

Increasing awareness of the complexity of human physiological/pathological response as well as behavioral response to vibration and the lack of clear, universally recognized dose-response relationships made it desirable to give more quantitative guidance on the effects of vibration on health and comfort as well as on perception and the incidence of motion sickness (see annexes B to D).

The frequency range in this revision is extended below 1 Hz and the evaluation is based on frequency weighting of the r.m.s. acceleration rather than the rating method. Different frequency weightings are given for the evaluation of different effects.

Based on practical experience, r.m.s. methods continue to be the basis for measurements for crest factors less than 9 and consequently the integrity of existing databases is maintained. Studies in recent years have pointed to the importance of the peak values of acceleration in the vibration exposure, particularly in health effects. The r.m.s. method of assessing vibration has been shown by several laboratories to underestimate the effects for vibration with substantial peaks. Additional or alternative measurement procedures are presented for vibration with occasional but substantial peaks and particularly for crest factors greater than 9. ISO 2631-5 provides an alternative assessment method for exposures dominated by multiple shocks in relation to health of the lumbar spine.

For simplicity, the dependency on exposure duration of the various effects on people had been assumed in ISO 2631-1:1985 to be the same for the different effects (health, working proficiency and comfort). This concept was not supported by research results in the laboratory and consequently has been removed. New approaches are outlined in the annexes. Exposure boundaries or limits are not included and the concept of “fatigue-decreased proficiency” due to vibration exposure has been deleted.

In spite of these substantial changes, improvements and refinements in this part of ISO 2631, the majority of reports or research studies indicate that the guidance and exposure boundaries recommended in ISO 2631-1:1985 were safe and preventive of undesired effects. This revision of ISO 2631 should not affect the integrity and continuity of existing databases and should support the collection of better data as the basis for the various dose-effect relationships.

## INTRODUCTION

The primary purpose of this part of ISO 2631 is to define methods of quantifying whole-body vibration in relation to

- human health and comfort;
- the probability of vibration perception;
- the incidence of motion sickness.

This part of ISO 2631 is concerned with whole-body vibration and excludes hazardous effects of vibration transmitted directly to the limbs (e.g. by power tools).

Vehicles (air, land and water), machinery (for example, those used in industry and agriculture) and industrial activities (such as piling and blasting), expose people to periodic, random and transient mechanical vibration which can interfere with comfort, activities and health.

This part of ISO 2631 does not contain vibration exposure limits. However, evaluation methods have been defined so that they may be used as the basis for limits which may be prepared separately. It contains methods for the evaluation of vibration containing occasional high peak values (having high crest factors).

Three annexes provide current information on the possible effects of vibration on health (annex B), comfort and perception (annex C) and on the incidence of motion sickness (annex D). This guidance is intended to take into account all the available data and to satisfy the need for recommendations which are simple and suitable for general application. The guidance is given in numerical terms to avoid ambiguity and to encourage precise measurements. However, when using these recommendations it is important to bear in mind the restrictions placed on their application. More information may be obtained from the scientific literature, a part of which is listed in annex E.

This part of ISO 2631 does not cover the potential effects of intense vibration on human performance and task capability since such guidance depends critically on ergonomic details related to the operator, the situation and the task design.

Vibration is often complex, contains many frequencies, occurs in several directions and changes over time. The effects of vibration may be manifold. Exposure to whole-body vibration causes a complex distribution of oscillatory motions and forces within the body. There can be large variations between subjects with respect to biological effects. Whole-body vibration may cause sensations (e.g. discomfort or annoyance), influence human performance capability or present a health and safety risk (e.g. pathological damage or physiological change). The presence of oscillatory force with little motion may cause similar effects.

NOTES

## AUSTRALIAN STANDARD

**Evaluation of human exposure to whole-body vibration****Part 1:  
General requirements****1 Scope**

This part of ISO 2631 defines methods for the measurement of periodic, random and transient whole-body vibration. It indicates the principal factors that combine to determine the degree to which a vibration exposure will be acceptable. Informative annexes indicate current opinion and provide guidance on the possible effects of vibration on health, comfort and perception and motion sickness. The frequency range considered is

- 0,5 Hz to 80 Hz for health, comfort and perception, and
- 0,1 Hz to 0,5 Hz for motion sickness.

Although the potential effects on human performance are not covered, most of the guidance on whole-body vibration measurement also applies to this area. This part of ISO 2631 also defines the principles of preferred methods of mounting transducers for determining human exposure. It does not apply to the evaluation of extreme-magnitude single shocks such as occur in vehicle accidents.

This part of ISO 2631 is applicable to motions transmitted to the human body as a whole through the supporting surfaces: the feet of a standing person, the buttocks, back and feet of a seated person or the supporting area of a recumbent person. This type of vibration is found in vehicles, in machinery, in buildings and in the vicinity of working machinery.

**2 Normative references**

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 2631. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 2631 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 2041:1990, *Vibration and shock — Vocabulary*.

ISO 5805:1997, *Mechanical vibration and shock — Human exposure — Vocabulary*.

ISO 8041:1990, *Human response to vibration — Measuring instrumentation*.

IEC 1260:1995, *Electroacoustics — Octave-band and fractional-octave-band filters*.