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Mechanical vibration and shock — Evaluation of human exposure to whole-body vibration —

Part 5:
Method for evaluation of vibration containing multiple shocks

Vibrations et chocs mécaniques — Évaluation de l'exposition des individus à des vibrations globales du corps —

Partie 5: Méthode d'évaluation des vibrations contenant des chocs répétés

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 108, *Mechanical vibration, shock and condition monitoring*, Subcommittee SC 4, *Human exposure to mechanical vibration and shock*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

This second edition cancels and replaces the first edition (ISO 2631-5:2004), which has been technically revised. The main changes compared to the previous edition are an improved description of the physiological response function for the exposure and improved guidance on the associated risk.

A list of all the parts in the ISO 2631 series can be found on the ISO website.

This corrected version of ISO 2631-5:2018 incorporates the following corrections:

— Figure 1: subclause numbers in the "Severe conditions" box were corrected as follows:

  — "Measurement (5.1)";

  — "Signal conditioning (5.1.3)";

  — "Evaluation (5.2, 5.3)";

  — "Risk injury (Annexes B and C)".

Introduction

The purpose of this document is to define a method of quantifying whole-body vibration containing multiple shocks in relation to human health in the seated posture. In biodynamics, the term “shock” is used to describe a wide range of short-time, high-magnitude exposures. It covers the range of severity starting at mild shocks resulting only in annoyance and brief discomfort up to magnitudes of shock sufficient to cause pain, injury or substantial physiological distress.

The methods described in this document can be appropriate for assessing the risk of chronic injury from exposure to repeated shock as can be experienced in military, commercial or recreational off-road vehicles, including agricultural vehicles, heavy plant equipment and high-speed marine craft. The methods are not intended to assess the probability of acute damage from a single impact.

The assessment methods described are based on the predicted biomechanical response of the bony vertebral endplate (hard tissue) in an individual who is in good physical condition with no evidence of spinal pathology. However, the risk assessment methods and related models described in this document have not yet been systematically epidemiologically validated. The methods provide nevertheless a quantitative description of the exposure, which is necessary to assess relative differences between exposures, e.g. the effects of some protective measures and different exposure conditions.

This document solely addresses lumbar spine response on the basis of studies indicating that the lumbar spine can be adversely affected by exposures to whole-body vibration[6][7][8][9][10][11][38][39][47][48][54][55] which also contain multiple shocks. Other adverse health effects of exposure to repeated shock, such as damage to parts of the body other than the lumbar spine, or types of short or long term health effects other than damage to the vertebral end plates, are not specifically considered by this document. Such end plate damage often cannot be differentiated by damages caused by other exposures (heavy lifting) and diseases.

This document considers only the effects of compressive loads from multiple shocks. To this end, a seat-to-lumbar spine transfer function of the measured acceleration has been developed for a default posture, body height and lumbar spine level. Another method to describe the spinal response is given in Annex A, which is valid only for a limited range of acceleration magnitudes but includes the effect of different postures, body heights and lumbar spine levels.

A standardized approach to the prediction of injury for non-vertical or combined axes shocks is complicated by the range of different postures and body restraint systems that can be employed in different vehicles and the limitations of current capabilities for predicting injury from non-vertical shock. Shocks involving horizontal, rotational or multi-axial motion are known to occur in practice and can present a significant risk of injury.

The risk of injury in the lumbar spine depends on an exposure dose, which is a combination of an exposure quantity and a duration. A manifest injury can take several years to develop. Due to the complexity of the measurement of multiple shocks, it is at the moment not possible to measure the exposure of the lifetime dose directly. Instead, the exposure is measured in representative situations and the dose is extrapolated from this measurement to a recorded exposure duration in the past or an anticipated exposure duration in the future. To monitor constantly the lifetime dose at a workplace, alternative measurement equipment will need to be developed, e.g. dosemeters.

