SLOVENSKI STANDARD
oSIST prEN ISO 7096:2018

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Stroji za zemeljska dela - Laboratorijski postopek za ovrednotenje vibracij voznikovega sedeža (ISO/DIS 7096:2018)

Earth-moving machinery - Laboratory evaluation of operator seat vibration (ISO/DIS 7096:2018)

Erdbaumaschinen - Laborverfahren zur Bewertung der Schwingungen des Maschinenführersitzes (ISO/DIS 7096:2018)

Engins de terrassement - Évaluation en laboratoire des vibrations transmises à l'opérateur par le siège (ISO/DIS 7096:2018)

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Earth-moving machinery — Laboratory evaluation of operator seat vibration

Engins de terrassement — Évaluation en laboratoire des vibrations transmises à l'opérateur par le siège

ICS: 13.160; 53.100

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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 127 *Earth-moving machinery*, Subcommittee SC 2, *Safety requirements and human factors*.

This second edition cancels and replaces the third edition (ISO 7096:2000), which has been technically revised.

The main changes compared to the previous edition are as follows:

— clause 1, horizontal direction drills added to the list of machines with low vertical vibration inputs;

— whole document, update of normative references;

— clause 5.4 5.4 Test person and posture, reference to the posture of the test person added and total mass of heavy person updated;

— clause 5.5.2 Damping test, informative note for bag filling;

— Table 2, Power Spectral Density of class EM 1 and EM 3 modified;

— Table 3, Filter cut-off frequencies of class EM 1 modified;

— Table 4, Characteristics of the simulated input vibration modified for the following machine types:

— Articulated or rigid frame dumper > 4 500 kg;

— Wheel loader > 4 500 kg.

Introduction

This document is a type-C standard as stated in ISO 12100.

The operators of earth-moving machinery are often exposed to a low frequency vibration environment partly caused by the movement of the vehicles over uneven ground and the tasks carried out. The seat constitutes the last stage of suspension before the driver. To be efficient at attenuating the vibration, the suspension seat should be chosen according to the dynamic characteristics of the vehicle. The design of the seat and its suspension are a compromise between the requirements of reducing the effect of vibration and shock on the operator and providing him with stable support so that he can control the machine effectively.

Thus, seat vibration attenuation is a compromise of a number of factors and the selection of seat vibration parameters needs to be taken in context with the other requirements for the seat.

The performance criteria provided in this International Standard have been set in accordance with what is attainable using what is at present the best design practice. They do not necessarily ensure the complete protection of the operator against the effects of vibration and shock. They may be revised in the light of future developments and improvements in suspension design.

The test inputs included in this International Standard are based on a very large number of measurements taken in situ on earth-moving machinery used under severe but typical operating conditions. The test methods are based on ISO 10326-1, which is a general method applicable to seats for different types of vehicles.

When requirements of this type-C standard are different from those which are stated in type-A or type- B standards, the requirements of this type-C standard take precedence over the requirements of the other standards for machines that have been designed and built according to the requirements of this type-C standard.

Earth-moving machinery — Laboratory evaluation of operator seat vibration

1 Scope

1.1 This International Standard specifies, in accordance with ISO 10326-1, a laboratory method for measuring and evaluating the effectiveness of the seat suspension in reducing the vertical whole-body vibration transmitted to the operator of earth-moving machines at frequencies between 1 Hz and 20 Hz. It also specifies acceptance criteria for application to seats on different machines.

1.2 This International Standard is applicable to operator seats used on earth-moving machines as defined in ISO 6165.

1.3 This International Standard defines the input spectral classes required for the following earth-moving machines. Each class defines a group of machines having similar vibration characteristics:

— rigid frame dumpers > 4 500 kg operating mass[1)];

— articulated frame dumpers;

— scrapers without axle or frame suspension[2)];

— wheel-loaders > 4 500 kg operating mass[1)];

— graders;

— wheel-dozers;

— soil compactors (wheel type);

— backhoe-loaders;

— crawler loaders;

— crawler-dozers ≤ 50 000 kg operating mass[1, 3)]

— compact dumpers ≤ 4 500 kg operating mass[1];

— compact loaders ≤ 4 500 kg operating mass[1)];

— skid-steer loader ≤ 4 500 kg operating mass[1)].

1.4 The following machines impart sufficiently low vertical vibration inputs at frequencies between 1 Hz and 20 Hz to the seat during operation that these seats do not require suspension for the attenuation of transmitted vibration:

— excavators, including walking excavators and cable excavators[4)];

1) See ISO 6016

2) For tractor scrapers with suspension, either a seat with no suspension may be used, or one having a suspension with high damping

3) For crawler dozers greater than 50 000 kg, the seat performance requirements are suitably provided by a cushion type seat

4) For excavators, the predominant vibration is generally in the fore and aft (X) axis

— trenchers;

— landfill compactors;

— non-vibratory rollers;

— milling machines;

— pipelayers;

— finishers;

— vibratory rollers;

— horizontal directional drills (HDD).

1.5 The tests and criteria defined in this International Standard are intended for operator seats used in earth-moving machines of conventional design.

NOTE Other tests may be appropriate for machines with design features that result in significantly different vibration characteristics.

1.6 Vibration which reaches the operator other than through his seat, for example that sensed by his feet on the platform or control pedals or by his hands on the steering-wheel, is not covered.

2 Normative references

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

ISO 2041:2009, *Mechanical vibration, shock and condition monitoring — Vocabulary*

ISO 2631-1:1997, *Mechanical vibration and shock — Evaluation of human exposure to whole-body vibration — Part 1: General requirements*

ISO 6016:2008, *Earth-moving machinery — Methods of measuring the masses of whole machines, their equipment and components*

ISO 6165:2012, *Earth-moving machinery — Basic types — Identification and terms and definitions*

ISO 8041-1:2017, *Human response to vibration — Measuring instrumentation — Part 1: General purpose vibration meters*

ISO 10326-1:2016, *Mechanical vibration — Laboratory method for evaluating vehicle seat vibration — Part 1: Basic requirements*

ISO 12100:2010, *Safety of machinery — General principles for design — Risk assessment and risk reduction*

ISO 13090-1:1998, *Mechanical vibration and shock — Guidance on safety aspects of tests and experiments with people — Part 1: Exposure to whole-body mechanical vibration and repeated shock*

3 Terms, definitions, symbols and abbreviations

3.1 Terms and definitions

For the purposes of this International Standard, the terms and definitions given in ISO 2041 and the following apply.

3.1.1
whole-body vibration
vibration transmitted to the body as a whole through the buttocks of a seated operator

3.1.2
input spectral class
machines having similar ride vibration characteristics at the seat attachment point, grouped by virtue of various mechanical characteristics

3.1.3
operating mass
mass of the base machine with equipment and empty attachment as specified by the manufacturer, and with the operator (75 kg), full fuel tank and all fluid systems at the levels specified by the manufacturer

[SOURCE: ISO 6016:2008, 3.2.1]

3.1.4
operator seat
that portion of the machine provided for the purpose of supporting the buttocks and back of the seated operator, including any suspension system and other mechanisms provided (for example, for adjusting the seat position)

3.1.5
frequency analysis
process of arriving at a quantitative description of a vibration amplitude as a function of frequency

3.1.6
measuring period
time duration in which vibration data for analysis is obtained

3.2 Symbols and abbreviations

For the purposes of this International Standard, the following symbols and abbreviations apply.

$a_P(f_r)$	Unweighted rms value of the measured vertical acceleration at the platform at the resonance frequency
a^*_{P12}, a^*_{P34}	Unweighted rms value of the target vertical acceleration at the platform under the seat (see Figure 3) between frequencies f_1 and f_2, or f_3 and f_4
a_{P12}, a_{P34}	Unweighted rms value of the measured vertical acceleration at the platform between frequencies f_1 and f_2, or f_3 and f_4
$a_S(f_r)$	Unweighted rms value of the measured vertical acceleration at the seat disk at the resonance frequency
a^*_{wP12}, a^*_{wP34}	Weighted rms value of the target vertical acceleration at the platform between frequencies f_1 and f_2, or f_3 and f_4
a_{wP12}	Weighted rms value of the measured vertical acceleration at the platform between frequencies f_1 and f_2
a_{wS12}	Weighted rms value of the measured vertical acceleration at the seat disk (see Figure 3) between frequencies f_1 and f_2
B_e	Resolution bandwidth, in hertz
F	Frequency, in hertz
F_r	Frequency at resonance

$G_P(f)$	Measured PSD of the vertical vibration at the platform (seat base)
$G^*_P(f)$	Target PSD of the vertical vibration at the platform (seat base)
$G^*_{PL}(f)$	Lower limit for the measured PSD of the vertical vibration at the platform (seat base)
$G^*_{PU}(f)$	Upper limit for the measured PSD of the vertical vibration at the platform (seat base)
$H(f_r)$	Transmissibility at resonance
PSD	Power Spectral Density, expressed as acceleration squared per unit bandwidth $(m/s^2)^2/Hz$ rms root mean square
SEAT	Seat Effective Amplitude Transmissibility factor
T_s	Sampling time, in seconds

4 General

4.1 The laboratory-simulated machine vertical vibration, specified as input spectral class, is based on representative measured data from machines in severe but typical working conditions. The input spectral class is a representative envelope for the machines within the class, as measured under severe conditions.

4.2 Two criteria are used for the evaluation of seat:

a) the Seat Effective Amplitude Transmissibility (SEAT) factor according to ISO 10326-1:2016, 10.2, but with frequency weighting according to ISO 2631-1;

b) the maximum transmissibility ratio in the damping test according to ISO 10326-1:2016, 10.2.

4.3 The measuring equipment shall be in accordance with ISO 8041-1 (type 1 instrument) and ISO 10326-1:2016, clauses 4 and 5. The frequency weighting shall include the effects of the band limiting filters, and be in accordance with ISO 2631-1.

4.4 Safety precautions shall be in accordance with ISO 13090-1.

Any compliant end-stops or devices normally fitted to production versions of the seat to be tested to minimise the effect of suspension overtravel shall be in place for the dynamic tests.

5 Test conditions and test procedure

5.1 General

The test conditions and test procedure shall be in accordance with ISO 10326-1:2016, clause 8 and 10.

5.2 Simulation of vibration

A platform, the dimensions of which correspond approximately to those of the operator's platform of an earth-moving machine, shall be mounted on a vibrator which is capable of generating vibration along the vertical axis (see Figure 1).

NOTE In the case of classes EM 1 and EM 2 the vibrator should be capable of simulating sinusoidal vibration having a displacement amplitude of at least ± 7,5 cm at a frequency of 2 Hz; see 5.4.1.

