June 2020

DIN 45669-1

ICS 17.160

Supersedes
DIN 45669-1:2019-09

Measurement of vibration immissions – Part 1: Vibration meters – Requirements and tests, English translation of DIN 45669-1:2020-06

Messung von Schwingungsimmissionen –
Teil 1: Schwingungsmesser –
Anforderungen und Prüfungen,
Englische Übersetzung von DIN 45669-1:2020-06

Mesure des immissions vibratoires –
Partie 1: Vibromètres –
Exigences et essais,
Traduction anglaise de DIN 45669-1:2020-06

Document comprises 71 pages

Translation by DIN-Sprachendienst.

In case of doubt, the German-language original shall be considered authoritative.

01.21 3174462

A comma is used as the decimal marker.

Contents

Foreword

This document has been prepared by Working Committee NA 001-03-09 AA (NALS/VDI C 9) “Measurement of vibration immission” of *DIN/VDI-Normenausschuss Akustik, Lärmminderung und Schwingungstechnik* (NALS) (DIN/VDI Standards Committee Acoustics, Noise Control and Vibration Engineering).

Vibration control regulations require measurements to be made in order to record and assess the effects of mechanical vibration on buildings or on humans in buildings, and to test the effectiveness of any protective measures taken. The uncertainty associated with the results of these measurements depends on the accuracy and stability of the vibration measuring system (vibration meter) used, as well as on the chosen measurement method and other factors, such as the source of the vibration (see DIN 45669-2).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. DIN and/or DKE shall not be held responsible for identifying any or all such patent rights.

The DIN 45669 series of standards consists of the following parts under the general title *Measurement of vibration immission*:

— *Part 1: Vibration meters — Requirements and tests*

— *Part 2: Measuring method*

Amendments

This document differs from DIN 45669-1:2010-09 and DIN 45669-1 Corrigendum 1:2012-12 as follows:

a) a method of testing the assessment velocity is now included;

b) the obligation to include an analogue output has been deleted;

c) an Annex on the estimation of the measurement uncertainty of the instrument is now included;

d) an Annex including a sample program code for creating and implementing the v_B filter function is now included.

The following corrections have been made to DIN 45669-1:2019-03:

a) references have been corrected;

b) symbols not used in the text have been deleted from Clause 4;

c) the numeration of clauses from Clause 6 onwards has been corrected.

The following corrections have been made to DIN 45669-1:2019-09:

a) internal references have been modified throughout the document;

b) normative references have been modified;

c) symbols have been added to Clause 4;

d) the numbering in subclauses 5.1, 5.2 and 6.2.3 has been corrected;

e) in 5.1.1, the missing numbering has been added, and numbers have been corrected in the figure;

f) 5.2.2 “Detection limit” has been added;

g) in footnote a of Table E.1 in Annex E, “$f_{\mathrm{Nyquist}} > 315$ Hz” has been changed to “$f_{\mathrm{Nyquist}} > 3 \times 315$ Hz”;

h) the example in Annex G has been corrected;

i) the Bibliography has been modified;

j) the standard has been editorially revised.

Previous editions

DIN 45669-1: 1981-01, 1995-06, 2010-09, 2019-03, 2019-09
DIN 45669-1 Corrigendum 1: 2012-12
DIN 45669-3: 2006-06

1 Scope

This document specifies requirements for vibration measuring systems (vibration meters) and specifies verification procedures that are graded in terms of effort and accuracy. These vibration meters can be used in the field of vibration control to measure mechanical vibrations affecting buildings and/or humans in buildings.

The requirements for frequency weighting and time averaging, which are fundamental to quantifying assessment parameters, follow from the specifications in DIN 4150-2 and DIN 4150-3, among others.

This document specifies the minimum extent of testing to be carried out by or on behalf of the manufacturer or user in order to verify that the requirements for the vibration meter have been met. The standard also specifies which information is to be included in the documentation of the relevant verification procedures.

Specifications regarding the verification process and the mounting of the vibration transducers are set out in DIN 45669-2. The assessment of the measured data for immission control purposes does not form part of this standard (see DIN 4150-2 and DIN 4150-3).

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

DIN 4150-2, *Vibrations in buildings — Part 2: Effects on persons in buildings*

DIN 4150-3:2016-12, *Vibrations in buildings — Part 3: Effects on structures*

DIN V ENV 13005, *Guide to the expression of uncertainty in measurement* [1]

DIN EN 60529 (VDE 0470-1), *Degrees of protection provided by enclosures (IP Code)*

DIN EN 61000-4-2 (VDE 0847-4-2), *Electromagnetic compatibility (EMC) — Part 4-2: Testing and measurement techniques — Electrostatic discharge immunity test*

DIN EN ISO 10012, *Measurement management systems — Requirements for measurement processes and measuring equipment*

DIN ISO 16063-21, *Methods for the calibration of vibration and shock transducers — Part 21: Vibration calibration by comparison to a reference transducer*

---

1 This is the German language edition of ISO/IEC Guide 98-3, *Uncertainty of measurement — Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)*. Although the German edition DIN V ENV 13005 has been withdrawn, it is still useful and is available from *Beuth Verlag*.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

DIN and DKE provide terminology databases for use in standardization at the following addresses:

— DIN-TERMinology Portal: available at https://www.din.de/en/services/din-term

— DKE-IEV: available at http://www.dke.de/DKE-IEV

3.1
measurand
vibrational displacement, vibrational velocity (particle velocity) or vibrational acceleration (particle acceleration) at the transducer as a wave form over time

3.2
transducer
absolute transducer for the chosen measurand whose output signal is a non-mechanical signal (measurement signal) that is proportional to the measurand

3.3
unweighted (velocity) signal
particle velocity signal
$v(t)$
band-limited signal proportional to the particle velocity

Note 1 to entry: For more information on bandwidth limitation, see 5.1.4.

Note 2 to entry: When measuring vibration in buildings, vibration velocity (particle velocity) is the preferred measurand because an approximately linear or close-to-linear relationship has been demonstrated between particle velocity and the stresses to which building components are subjected when exposed to steady-state or transient vibration. The ability of humans to perceive vibration at any one instant in time is also directly proportional to vibration velocity over most of the operating frequency range specified here. In addition, by recording vibration velocity over time, information can be gained about how vibration displacement or vibration acceleration varies over time, even in the case of composite vibrations with different amplitudes. This would be more difficult if, for instance, acceleration was chosen as the measurand, as the frequency-dependence of the vibration acceleration means that the higher-frequency amplitudes would dominate.

3.4 Signal inputs

3.4.1
digital input
interface in the signal path on the input side of the vibration meter at which time series of the unweighted signal (particle velocity signal) $v(t)$ can be fed in for the purposes of testing the meter or for subsequently analysing the measurement data recorded

Note 1 to entry: Signals can be fed in as block-serial input.

3.4.2
analogue input
electrical input port on the vibration meter for either analogue electrical signals proportional to the unweighted signal (particle velocity signal) $v(t)$ or for a test signal used for verification purposes

3.5
signal conditioner
part of the vibration meter that limits bandwidth and in which the transducer output is converted into the unweighted velocity signal

EXAMPLE The signal conditioner may include amplifiers, integrators, differentiators, frequency response equalizers for the transducer or any combination thereof.

3.6
band limits
upper and lower cutoff frequencies of the vibration meter's operating frequency range

Note 1 to entry: See 3.17 for more information on the relationship between the corner frequencies of the band-limiting filter and the cutoff frequencies of the meter's operating frequency range

3.7
peak particle velocity
$|v|_{max}$
maximum absolute value of the unweighted signal (particle velocity signal) $v(t)$ over the duration of the measurement T_M

3.8
weighting filter
part of the vibration meter that uses frequency weighting to convert the unweighted signal (particle velocity signal) into a *KB* signal or v_B

Note 1 to entry: While the weighting filter is, in principle, independent of the band-limiting filter, the simultaneous effect of both filters is usually taken into account.

3.9
frequency-weighted signal
signal that results from applying a weighting filter to the unweighted signal (particle velocity signal)

Note 1 to entry: A frequency-weighted signal arises from applying a frequency weighting function (see Equation (4), Figure 4 or Annex E). Although this standard only covers the frequency weighting of vibration velocity (particle velocity) signals, it is also possible to weight signals that are proportional to vibration displacement or acceleration.

3.10 Weighted quantities

3.10.1 *KB*-related signals

3.10.1.1
***KB* signal**
$KB(t)$
velocity signal that is frequency-weighted and normalized to 1 mm/s

Note 1 to entry: For details on *KB* frequency weighting, see Equation (4), Figure 4 and Annex B. The *KB* signal is dimensionless.

3.10.1.2
KB_F signal
weighted vibration severity
$KB_F(t)$
running root-mean-square (RMS) time average of the *KB(t)* signal obtained by averaging the exponentially weighted squared values of *KB(t)* over the interval of interest and then taking the square root of this average, as given by Equation (1):

$$KB_{\mathrm{F}}(t)=\sqrt{\frac{1}{\tau}\int_{\xi=0}^{t}e^{-\frac{t-\xi}{\tau}}KB^{2}(\xi)\ d\xi} \qquad (1)$$

where

$\tau = 0{,}125$ s is the time constant;

ξ is the integration variable;

F is the subscript for “fast”, abbreviation for $\tau = 0{,}125$ s.

Note 1 to entry: To calculate the running RMS value of the KB signal using “fast” exponential time weighting, a time constant of $\tau = 0{,}125$ s is specified. This time constant is used in the assessment of human response to vibration as detailed in DIN 4150-2. The fluctuating indications at very low frequencies (< 5 Hz) have been taken into account when formulating the assessment criteria.

Note 2 to entry: Instantaneous values of the $KB_{\mathrm{F}}(t)$ signal are referred to as the weighted vibration severity KB_{F}.

3.10.1.3
maximum weighted vibration severity
KB_{Fmax}
maximum value of the $KB_{\mathrm{F}}(t)$ signal over the time averaging period T_{m}

3.10.1.4
maximum cycle KB_{F} value
KB_{FT}
maximum value of the $KB_{\mathrm{F}}(t)$ signal over the cycle period T

Note 1 to entry: The requirements for the cycle period are specified in 5.1.6.4.

3.10.1.5
energy-averaged $\mathrm{KB_{FT}}$ value
KB_{FTm}
root-mean-square value of the KB_{FTi} values recorded during the time averaging period $T_{\mathrm{m}} = N \cdot T$ where N is the number of cycles each of duration T, calculated using the following equation, in which KB_{FTi} values less than or equal to 0,1 ($KB_{\mathrm{FTi}} \leq 0{,}1$) are taken to be zero though these cycles contribute to the total number of cycles N:

$$KB_{\mathrm{FTm}}=\sqrt{\frac{1}{N}\sum_{i=1}^{N}KB_{\mathrm{FT}i}^{2}} \qquad (2)$$

3.10.2 Frequency-weighted quantities for describing the effects of transient vibrations on buildings

3.10.2.1
assessment velocity
v_{B}
frequency-weighted vibration velocity used in assessing transient vibration impacts on buildings

Note 1 to entry: DIN 4150-3:2016-12, Table 1, distinguishes between the following assessment velocities when assessing the effects of transient vibrations on building structures:

v_{B1} for buildings used for commercial purposes, industrial buildings, and buildings of similar design,

v_{B2} for dwellings and/or buildings of similar design,

v_{B3} for structures that are particularly sensitive to vibration.