# SLOVENSKI STANDARD
# SIST EN 1032:2000/A1:2000

**01-april-2000**

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**Mechanical vibration - Testing of mobile machinery in order to determine the whole-body vibration emission value - General - Amendment 1**

Mechanical vibration - Testing of mobile machinery in order to determine the whole-body vibration emission value - General - Amendment 1

Mechanische Schwingungen - Prüfverfahren zur Ermittlung der Ganzkörper-Schwingungen von beweglichen Maschinen - Allgemeines - Änderung 1



Vibrations mécaniques - Essai des machines mobiles dans le but de déterminer l'intensité vibratoire transmise a l'ensemble du corps - Généralités - Amendement 1



**Ta slovenski standard je istoveten z:** **EN 1032:1996/A1:1998**

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**ICS:**

| | | |
|---|---|---|
| 13.160 | Vpliv vibracij in udarcev na ljudi | Vibration and shock with respect to human beings |

**SIST EN 1032:2000/A1:2000** **en**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

**EN 1032:1996/A1**

November 1998

ICS 13.160; 17.160

Descriptors: machinery, tests, vibration, human body, measurements, vibration severity, human factors engineering, work safety, testing conditions, specifications

English version

# Mechanical vibration - Testing of mobile machinery in order to determine the whole-body vibration emission value - General - Amendment 1

Vibrations mécaniques - Essai des machines mobiles dans le but de déterminer l'intensité vibratoire transmise à l'ensemble du corps - Généralités - Amendement 1

Mechanische Schwingungen - Prüfverfahren zur Ermittlung der Ganzkörper-Schwingungen von beweglichen Maschinen - Allgemeines - Änderung 1

This amendment A1 modifies the European Standard EN 1032:1996; it was approved by CEN on 22 October 1998.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for inclusion of this amendment into the relevant national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This amendment exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.



EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

**Central Secretariat: rue de Stassart, 36 B-1050 Brussels**



Ref. No. EN 1032:1996/A1:1998 E

**Foreword**

This Amendment EN 1032:1996/A1:1998 to EN 1032:1996 has been prepared by Technical Committee CEN/TC 231 "Mechanical vibration and shock", the secretariat of which is held by DIN.

This Amendment to the European Standard EN 1032:1996 shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by May 1999, and conflicting national standards shall be withdrawn at the latest by May 1999.

This Amendment to the European Standard EN 1032:1996 has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.



Amend EN 1032:1996 as follows:



Clause 1: *Replace in the first paragraph* 1 Hz *with* 0,5 Hz.

Clause 2: *Add to the list of normative references*

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

4.3.2: *Delete the last sentence in the first paragraph.*

4.3.2: *Replace the second paragraph with the following*

Different frequency weightings (corresponding to frequency weightings $W_k$ and $W_d$ in ISO 2631-1) are used in the longitudinal direction (z axis, $W_k$) and in the transverse directions (x and y axes, $W_d$). The frequency weighting curves are given in figure 2.

Within the nominal frequency band (0,5 Hz to 80 Hz) and one-third octave from the frequency limits, the tolerance of the combined frequency weighting and band limiting shall be ± 1 dB (i. e. in the range from 0,63 Hz to 63 Hz). Outside this range, the tolerance shall be ± 2 dB. One octave outside the nominal frequency band, the attenuation may extend to infinity.

Figures 2 and 3: *Substitute figures 2 and 3 with the following figure*

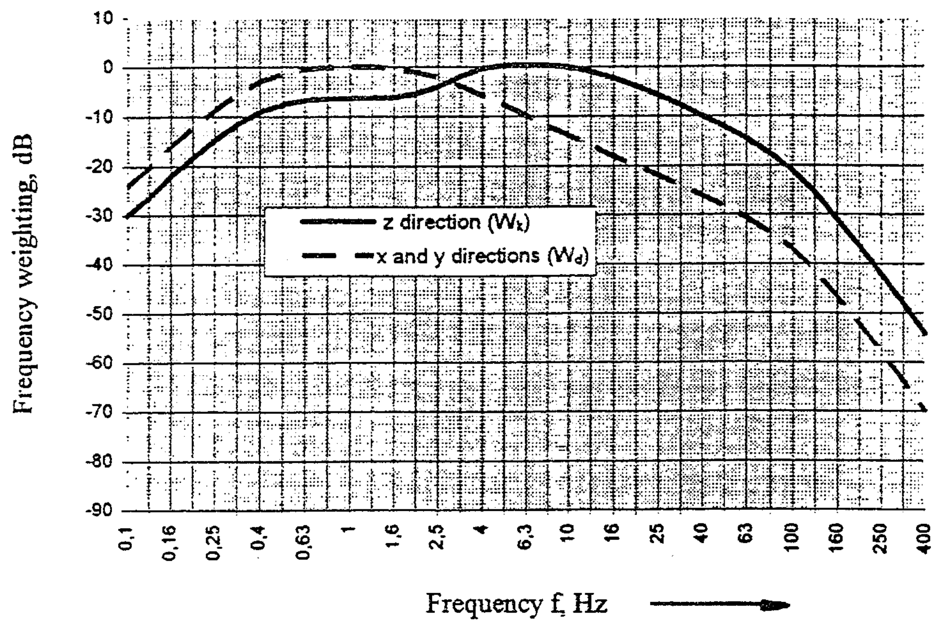


**Figure 2: Frequency weighting curves**

5.2 and figure 4: *Replace in* 5.2, *third paragraph and in figure 4* figure 4 *with* figure 3.

5.3: *Replace in b)* 1 Hz *with* 0,5 Hz *and substitute the last paragraph with the following*

In case the frequency range to be measured shall be more limited than 0,5 Hz to 80 Hz, it shall be specified in the relevant vibration test code.



NOTE: If it has been established that the frequency range below 1 Hz is not relevant nor important, a frequency range from 1 Hz to 80 Hz can be substituted. The frequency range to be measured may also be more limited than 1 Hz to 80 Hz (e. g. in artificial testing).

Annex A: *Substitute the present annex A with the following annex*

**Annex A** (informative)

**Analytical expressions of the frequency weightings**

**Table A.1: Parameters of the transfer function of the frequency weightings**

| Weighting | band limiting | | acceleration-velocity transition (a-v transition) | | | upward step | | | |
|---|---|---|---|---|---|---|---|---|---|
| | $f_1$ Hz | $f_2$ Hz | $f_3$ Hz | $f_4$ Hz | $Q_4$ | $f_5$ Hz | $Q_5$ | $f_6$ Hz | $Q_6$ |
| $W_k$ | 0,4 | 100 | 12,5 | 12,5 | 0,63 | 2,37 | 0,91 | 3,35 | 0,91 |
| $W_d$ | 0,4 | 100 | 2,0 | 2,0 | 0,63 | ∞ | – | ∞ | – |

The frequencies $f_1, \ldots, f_6$ and the resonance quality factors $Q_4, \ldots, Q_6$ are parameters of the transfer function (below) determining the overall frequency weighting (referred to acceleration as input quantity). The transfer function is expressed as product of several factors where $\omega_i = 2\pi f_i$:

**Band limiting** (second order Butterworth characteristic)

High pass $$|H_h(p)| = \left| \frac{1}{1+\sqrt{2}\,\omega_1/p+(\omega_1/p)^2} \right| = \sqrt{\frac{f^4}{f^4+f_1^4}} \qquad (A.1)$$

Low pass $$|H_l(p)| = \left| \frac{1}{1+\sqrt{2}\,p/\omega_2+(p/\omega_2)^2} \right| = \sqrt{\frac{f_2^4}{f^4+f_2^4}} \qquad (A.2)$$

**Acceleration-velocity transition**

$$|H_t(p)| = \left| \frac{1+p/\omega_3}{1+p/(Q_4\omega_4)+(p/\omega_4)^2} \right| = \sqrt{\frac{f^2+f_3^2}{f_3^2}} \sqrt{\frac{f_4^4 \cdot Q_4^2}{f^4 \cdot Q_4^2 + f^2 \cdot f_4^2(1-2Q_4^2)+f_4^4 \cdot Q_4^2}} \qquad (A.3)$$



**Upward step** (steepness approximately 6 dB per octave, proportionality to jerk)

$$|H_s(p)| = \left| \frac{1+p/(Q_5\cdot\omega_5)+(p/\omega_5)^2}{1+p/(Q_6\cdot\omega_6)+(p/\omega_6)^2} \cdot \left(\frac{\omega_5}{\omega_6}\right)^2 \right| = \frac{Q_6}{Q_5} \cdot \sqrt{\frac{f^4\cdot Q_5^2+f^2\cdot f_5^2(1-2Q_5^2)+f_5^4\cdot Q_5^2}{f^4\cdot Q_6^2+f^2\cdot f_6^2(1-2Q_6^2)+f_6^4\cdot Q_6^2}} \qquad (A.4)$$

The product $H_h(p) \cdot H_l(p)$ represents the band-limiting transfer function; it is the same for both frequency weightings.

The product $H_t(p) \cdot H_s(p)$ represents the actual frequency weighting transfer function for a certain application. $H_s(p) = 1$ for frequency weighting $W_d$. This is indicated by infinity frequencies and absence of quality factors in table A.1.

The total frequency weighting function is

$$H(p) = H_h(p) \cdot H_l(p) \cdot H_t(p) \cdot H_s(p) \qquad (A.5)$$

In the most common interpretation of this equation (in the frequency domain) it describes the modulus (magnitude) and phase in the form of a complex number as a function of the imaginary angular frequency, $p = j2\pi f$. The quantity $p$ may be interpreted as the variable of the Laplace transform.

Table A.2 contains the frequency weightings, including band limitation, in one-third octaves.

**Table A.2: Frequency weightings, including band limitation, in one-third octaves**

| x | *f* Hz | $W_k$ factor x 1000 | $W_k$ dB | $W_d$ factor x 1000 | $W_d$ dB |
|---|---|---|---|---|---|
| -10 | 0,1 | 31,2 | -30,11 | 62,4 | -24,09 |
| -9 | 0,125 | 48,6 | -26,26 | 97,3 | -20,24 |
| -8 | 0,16 | 79,0 | -22,05 | 158 | -16,01 |
| -7 | 0,2 | 121 | -18,33 | 243 | -12,28 |
| -6 | 0,25 | 182 | -14,81 | 365 | -8,75 |
| -5 | 0,315 | 263 | -11,60 | 530 | -5,52 |
| -4 | 0,4 | 352 | -9,07 | 713 | -2,94 |
| -3 | 0,5 | 418 | -7,57 | 853 | -1,38 |
| -2 | 0,63 | 459 | -6,77 | 944 | -0,50 |
| -1 | 0,8 | 477 | -6,43 | 992 | -0,07 |
| 0 | 1 | 482 | -6,33 | 1011 | 0,10 |
| 1 | 1,25 | 484 | -6,29 | 1008 | 0,07 |
| 2 | 1,6 | 494 | -6,12 | 968 | -0,28 |
| 3 | 2 | 531 | -5,49 | 890 | -1,01 |
| 4 | 2,5 | 631 | -4,01 | 776 | -2,20 |
| 5 | 3,15 | 804 | -1,90 | 642 | -3,85 |
| 6 | 4 | 967 | -0,29 | 512 | -5,82 |
| 7 | 5 | 1039 | 0,33 | 409 | -7,76 |
| 8 | 6,3 | 1054 | 0,46 | 323 | -9,81 |
| 9 | 8 | 1036 | 0,31 | 253 | -11,93 |
| 10 | 10 | 988 | -0,10 | 212 | -13,91 |
| 11 | 12.5 | 902 | -0,89 | 161 | -15,87 |
| 12 | 16 | 768 | -2,28 | 125 | -18,03 |
| 13 | 20 | 636 | -3,93 | 100 | -19,99 |
| 14 | 25 | 513 | -5,80 | 80,0 | -21,94 |
| 15 | 31,5 | 405 | -7,86 | 63,2 | -23,98 |
| 16 | 40 | 314 | -10,05 | 49,4 | -26,13 |
| 17 | 50 | 246 | -12,19 | 38,8 | -28,22 |
| 18 | 63 | 186 | -14,61 | 29,5 | -30,60 |
| 19 | 80 | 132 | -17,56 | 21,1 | -33,53 |
| 20 | 100 | 88,7 | -21,04 | 14,1 | -36,99 |
| 21 | 125 | 54,0 | -25,35 | 8,63 | -41,28 |
| 22 | 160 | 28,5 | -30,91 | 4,55 | -46,84 |
| 23 | 200 | 15,2 | -36,38 | 2,43 | -52,30 |
| 24 | 250 | 7,90 | -42,04 | 1,26 | -57,97 |
| 25 | 315 | 3,98 | -48,00 | 0,64 | -63,92 |
| 26 | 400 | 1,95 | -54,20 | 0,31 | -70,12 |

Index x is the frequency band number according to EN 61260.

Annex B: *Replace in c)* 1 Hz *with* 0,5 Hz.

Annex D: *Add the following reference*

EN 61260 Electroacoustics – Octave-band and fractional-octave-band filters (IEC 61260:1995)