HSPI The Open Access Publisher

I J P R A INTERNATIONAL JOURNAL OF PHYSICS RESEARCH AND APPLICATIONS
ISSN 2766-2748

Research Article

Determination of Permissible and Standardized Parameters of Vibrations and Noise

Levan Gavasheli[1]* and Anri Gavasheli[2]

[1]Academy of Physical and Mathematical Sciences, Tbilisi, Georgia
[2]BS (Bachelor of Science) in Economics with Mathematical Concentration, Drexel University, Philadelphia, USA

Abstract

To determine the permissible and standardized parameters for vibrations and noise, it is primarily important to classify people's (engineer-operators') workplaces according to their working conditions. Vibrations that affect engineer-operators develop according to two categories: General and local. The effects of general vibration on a person can depend on the overall condition of the work environment, the support surface at the workplace, and whether the machine operator is seated or standing.

More Information

***Corresponding author:** Levan Gavasheli, Prof. Academy of Physical and Mathematical Sciences, Tbilisi, Georgia, Email: levan_gavasheli@yahoo.com

Submitted: April 04, 2026
Accepted: April 20, 2026
Published: April 21, 2026

Citation: Gavasheli L, Gavasheli A. Determination of Permissible and Standardized Parameters of Vibrations and Noise. Int J Phys Res Appl. 2026; 9(3): 071-077. Available from: https://dx.doi.org/10.29328/journal.ijpra.1001149

Keywords: Vibration analysis Noise standards; Vibration velocity; Vibration acceleration; Occupational safety; Frequency weighting; ISO 2631-1; Environmental noise

Objectives

The primary objectives of this study are:

- To classify vibration types affecting human operators based on working conditions and sources.
- To determine permissible vibration velocity and acceleration levels using standardized analytical methods.
- To establish relationships between logarithmic vibration levels and their physical values.
- To develop tabulated reference standards for different categories of vibration exposure.

To define permissible noise levels in residential, industrial, and institutional environments.

Introduction

General vibrations, based on their origin and purpose, can be divided into the following categories:

Category 1 - transportation vibrations, which affect a person when they operate vehicles such as: self-propelled and towed self-propelled machines; industrial and agricultural tractors; combines; trucks; mining rail transport and other similar machinery: graders; snow plows; scrapers, etc. Category 2 - Transport - technological vibrations transmitted to humans from machines and equipment such as: excavators; industrial and construction lifting equipment [1]; drilling machines; concrete pouring machines; and other similar operating equipment. Category 3 – Technological vibrations transmitted to humans from stationary machines such as: wood and metal processing equipment; pressing devices; casting machines; stationary electrical machines; drilling machines; pumping equipment and fans; chemical and petrochemical process equipment, etc. Vibrations of this category can also affect people in design offices and laboratories where the machines causing the vibrations are not directly present. According to direction, vibrations can be divided based on the orthogonal axes of coordinates (x_0, y_0, z_0). z_0 is vertical, when a person is seated or standing relative to the supporting surface — that is, in a vertical posture; x_0 and y_0 are horizontal, when a person is in a posture parallel to the supporting surface. According to spectral composition, vibrations can be classified as follows: narrowband, when the control parameters in a 1/3-octave band exceed those in the adjacent 1/3-octave band by 15 dB; broadband, which do not meet the above condition; low-frequency, when the maximum vibration levels are in the octave band from 1 to 4 Hz; mid-frequency, when they are from 8 to 16 Hz high frequency, when they are from 31.5 to

63 Hz. Vibrations affecting a person are classified according to their duration:

- relatively short-duration vibrations, when the vibration frequency exceeds 6 dB per second;
- relatively long-duration vibrations, when the vibration frequency is less than 6 dB per second. Non-continuous vibrations include intermittent vibrations, when human contact with the source of vibrations is interrupted for a certain period (the interruption interval is more than 1 second). Vibrations whose vibration velocity levels change continuously over time; impulse vibrations (for example, shocks), whose duration is at least 1 second. The hygienic assessment of vibrations affecting a person can be based on several convenient methods:

$$L_c = 20\lg\frac{v}{5\cdot 10^{-8}},$$

where v is the root mean square value of the vibration acceleration in m/s^2; is the standard value of the vibration velocity, corresponding to the root mean square value when exposed to a sound tone with a frequency of 1000 Hz at a stress of $2{,}0\cdot 10^{-5}$ N/m^2. The relationship between the logarithmic levels of vibration velocities (in dB) and their corresponding values in m/s^2 is given in the first table [2].

Methodology

The study adopts an analytical and standards-based approach to evaluate vibration and noise parameters. Vibration levels are assessed using root mean square (RMS) values of vibration velocity and acceleration, which are widely applied in vibration analysis and mechanical system evaluation [3,4]. The logarithmic levels of vibration are calculated using standard equations relating physical quantities to decibel (dB) scales [3].

Frequency-weighted analysis is performed across octave (1/1) and one-third octave (1/3) bands using weighting coefficients (Ki) corresponding to each frequency range. These coefficients are applied to determine corrected vibration values, ensuring compatibility with human sensitivity and standard measurement practices [4,5,6].

The evaluation includes:

- Classification of vibrations into general and local categories
- Analysis of spectral composition (low, medium, high frequency ranges)
- Calculation of equivalent energy exposure over time
- Use of tabulated standard values derived from recognized references

All parameters are analyzed in accordance with established engineering principles and aligned with internationally recognized standards such as ISO 2631-1 and vibration exposure guidelines [4,7,8].

Results

The study presents a comprehensive set of tabulated values representing permissible vibration and noise parameters across different working conditions and frequency ranges. The results demonstrate clear relationships between vibration levels expressed in decibels and their corresponding physical quantities (m/s^2), consistent with established vibration analysis principles [3,9].

The analysis indicates that:

Vibration intensity increases with frequency in specific operational ranges, as supported by standard vibration behavior models [3,9].

Transportation and technological vibrations exhibit distinct permissible limits depending on exposure duration, consistent with international standards [4,8].

Frequency-weighted coefficients significantly influence the corrected vibration values and exposure assessment [6,9].

Noise levels vary across environments, with stricter limits observed in medical and educational institutions compared to commercial areas, in line with environmental health guidelines [10,11].

The tabulated data (Tables 1–9) provide a structured reference framework for assessing vibration exposure and ensuring compliance with safety standards [4,7].

The values of the logarithmic levels of vibration accelerations are calculated using the formula.

$$L_a = 20\lg\frac{\alpha}{3\cdot 10^{-4}},$$

where a is the root mean square value of vibration acceleration in m/s^2;

Given value is the basic value of vibration acceleration in m/s^2. The ratio of the logarithmic levels of vibration accelerations (in dB) and their corresponding values in m/s^2 is given in the second table, [12].

The integral formation of the normalized parameters of vibration velocities and vibration accelerations is carried out using their corrected values.

$$\tilde{v} = \sqrt{\sum_{i=1}^{n}(v_i K_i)^2}$$

$$L\tilde{v} = 10\cdot\lg\sum_{i=1}^{n}10^{0,1(L_{vi}/L_{Ki})},$$

where L_{vi} - are the root mean square values of vibration velocities and vibration accelerations; n - is the number

Table**1:**

Tens, dB	Units								db	
	0	1	2	3	4	5	6	7	8	9
50	$1,6\cdot10^{-5}$	$1,8\cdot10^{-5}$	$2,0\cdot10^{-5}$	$2,2\cdot10^{-5}$	$2,5\cdot10^{-5}$	$2,8\cdot10^{-5}$	$3,2\cdot10^{-5}$	$3,5\cdot10^{-5}$	$4,0\cdot10^{-5}$	$4,5\cdot10^{-5}$
60	$5,0\cdot10^{-5}$	$5,6\cdot10^{-5}$	$6,3\cdot10^{-5}$	$7,1\cdot10^{-5}$	$7,9\cdot10^{-5}$	$8,9\cdot10^{-5}$	$1,0\cdot10^{-4}$	$1,1\cdot10^{-4}$	$1,3\cdot10^{-4}$	$1,4\cdot10^{-4}$
70	$1,6\cdot10^{-4}$	$1,8\cdot10^{-4}$	$2,0\cdot10^{-4}$	$2,2\cdot10^{-4}$	$2,5\cdot10^{-4}$	$2,8\cdot10^{-4}$	$3,2\cdot10^{-4}$	$3,5\cdot10^{-4}$	$4,0\cdot10^{-4}$	$4,5\cdot10^{-4}$
80	$5,0\cdot10^{-4}$	$5,6\cdot10^{-4}$	$6,3\cdot10^{-4}$	$7,0\cdot10^{-4}$	$7,9\cdot10^{-4}$	$8,9\cdot10^{-4}$	$1,0\cdot10^{-3}$	$1,1\cdot10^{-3}$	$1,3\cdot10^{-3}$	$1,4\cdot10^{-3}$
90	$1,6\cdot10^{-3}$	$1,8\cdot10^{-3}$	$2,0\cdot10^{-3}$	$2,2\cdot10^{-3}$	$2,3\cdot10^{-3}$	$2,8\cdot10^{-3}$	$3,2\cdot10^{-3}$	$3,5\cdot10^{-3}$	$4,0\cdot10^{-3}$	$4,5\cdot10^{-3}$
100	$5,0\cdot10^{-3}$	$5,6\cdot10^{-3}$	$6,3\cdot10^{-3}$	$7,0\cdot10^{-3}$	$7,9\cdot10^{-3}$	$8,9\cdot10^{-3}$	$1,0\cdot10^{-3}$	$1,1\cdot10^{-2}$	$1,3\cdot10^{-2}$	$1,4\cdot10^{-2}$
110	$1,6\cdot10^{-2}$	$1,8\cdot10^{-2}$	$2,0\cdot10^{-2}$	$2,2\cdot10^{-2}$	$2,5\cdot10^{-2}$	$2,8\cdot10^{-2}$	$3,2\cdot10^{-2}$	$3,5\cdot10^{-2}$	$4,0\cdot10^{-2}$	$4,5\cdot10^{-2}$
120	$5,0\cdot10^{-2}$	$5,6\cdot10^{-2}$	$6,3\cdot10^{-2}$	$7,1\cdot10^{-2}$	$7,9\cdot10^{-2}$	$8,9\cdot10^{-2}$	$1,0\cdot10^{-1}$	$1,1\cdot10^{-1}$	$1,3\cdot10^{-1}$	$1,4\cdot10^{-1}$
130	$1,6\cdot10^{-1}$	$1,8\cdot10^{-1}$	$2,0\cdot10^{-1}$	$2,2\cdot10^{-1}$	$2,5\cdot10^{-1}$	$2,8\cdot10^{-1}$	$3,2\cdot10^{-1}$	$3,5\cdot10^{-1}$	$4,0\cdot10^{-1}$	$4,5\cdot10^{-1}$
140	$5,0\cdot10$	$5,6\cdot10^{-1}$	$6,3\cdot10$	$7,0\cdot10$	$7,9\cdot10$	$8,9\cdot10^{-1}$	1,0	1,1	1,3	1,4

Table 2

Tens, dB	Units								db	
	0	1	2	3	4	5	6	7	8	9
10	$3,3\cdot10^{-3}$	$3,4\cdot10^{-3}$	$3,8\cdot10^{-3}$	$4,2\cdot10^{-3}$	$4,8\cdot10^{-3}$	$5,3\cdot10^{-3}$	$6,0\cdot10^{-3}$	$6,7\cdot10^{-3}$	$7,6\cdot10^{-3}$	$8,5\cdot10^{-3}$
20	$9,5\cdot10^{-3}$	$1,1\cdot10^{-2}$	$1,2\cdot10^{-2}$	$1,3\cdot10^{-2}$	$1,5\cdot10^{-2}$	$1,7\cdot10^{-2}$	$1,9\cdot10^{-2}$	$2,1\cdot10^{-3}$	$2,4\cdot10^{-2}$	$2,7\cdot10^{-2}$
30	$3,0\cdot10^{-2}$	$3,4\cdot10^{-2}$	$3,8\cdot10^{-2}$	$4,2\cdot10^{-2}$	$4,8\cdot10^{-2}$	$5,3\cdot10^{-2}$	$6,0\cdot10^{-2}$	$6,7\cdot10^{-2}$	$7,6\cdot10^{-2}$	$8,5\cdot10^{-2}$
40	$9,5\cdot10^{-2}$	$1,1\cdot10^{-2}$	$1,2\cdot10^{-1}$	$1,3\cdot10^{-1}$	$1,5\cdot10^{-1}$	$1,7\cdot10^{-1}$	$1,9\cdot10^{-2}$	$2,1\cdot10^{-1}$	$2,4\cdot10^{-1}$	$2,7\cdot10^{-1}$
50	$3,0\cdot10^{-1}$	$3,4\cdot10^{-1}$	$3,8\cdot10^{-1}$	$4,2\cdot10^{-1}$	$4,8\cdot10^{-1}$	$5,3\cdot10^{-1}$	$6,0\cdot10^{-1}$	$6,7\cdot10^{-1}$	$7,6\cdot10^{-1}$	$8,5\cdot10^{-1}$
60	$9,5\cdot10^{-1}$	1,1	1,2	1,3	1,5	1,7	1,9	2,1	2,4	2,7
70	3,0	3,4	3,8	4,2	4,8	5,3	6,0	6,7	7,6	8,5
80	9,5	$1,1\cdot10$	$1,2\cdot10$	$1,3\cdot10$	$1,5\cdot10$	$1,7\cdot10$	$1,9\cdot10$	$2,1\cdot10$	$2,4\cdot10$	$2,7\cdot10$
90	$3,0\cdot10$	$3,4\cdot10$	$3,8\cdot10$	$4,2\cdot10$	$4,8\cdot10$	$5,3\cdot10$	$6,0\cdot10$	$6,7\cdot10$	$7,6\cdot10$	$8,5\cdot10$
100	$9,5\cdot10$	$1,1\cdot10^{-2}$	$1,2\cdot10^{-2}$	$1,3\cdot10^{-2}$	$1,5\cdot10^{-2}$	$1,7\cdot10^{2}$	$1,9\cdot10^{-2}$	$2,1\cdot10^{2}$	$2,4\cdot10^{2}$	$2,7\cdot10^{2}$

Table 3

Average geometric value of frequency, Hz.	For vibration speed								For vibration accelerators							
	1/3 in Octave				1/1 in Octave				1/3 in Octave				1/1 in Octave			
	Z_0		X_0	Y_0	Z_0		X_0	Y_0	Z_0		X_0	Y_0	Z_0		X_0	Y_0
	Ki	LKi	Ki	LKi	Ki	LKi	Ki	LKi	Ki	LKi	Ki	LKi	Ki	LKi	Ki	LKi
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
0,8	0,45	-7	1,0	0	0,5	-6	1,0	0	0,045	-27	0,4	-8	0,45	-0,25	0,5	-6
1,0	0,5	-6	1,0	0	0,4	-5	1,2	0,1	0,063	-24	0,5	-6	0,33	-0,30	0,6	-7
1,25	0,56	-5	1,0	0	0,6	-6	1,1	0,1	0,09	-21	0,63	-4	0,23	-0,33	0,55	-5
1,6	0,63	-4	1,0	0	0,71	-3	1,0	0	0,125	-18	0,8	-2	0,16	-0,25	0,5	-6
2,0	0,71	-3	1,0	0	0,65	-7	1,0	0,2	0,188	-15	1,0	0	0,34	-0,40	0,45	-6
2,5	0,8	-2	0,8	-2	0,55	-4	1,1	0,1	0,25	-12	1,0	0	0,44	-0,23	0,50	-5
3,15	0,9	-1	0,63	-4	1,0	0	0,5	-6	0,35	-9	1,0	0	0,45	-7	1,0	0
4,0	1,0	0	0,5	-6					0,5	-6	1,0	0				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
5,0	1,0	0	0,4	-8	2,5	1,23	1,50	1,54	0,63	-4	1,0	0	0,8	-1	1,0	0
6,3	1,0	0	0,315	-10	1,0	0	0,25	-12	0,8	-2	1,0	0	0,9	-1	1,0	0
8,0	1,0	0	0,25	-12	0,9	1	0,3	-11	1,0	0	1,0	0	0,7	0	1,0	0,1
10,0	0,8	-2	0,2	-14	0,8	3	0,21	-12	1,0	0	1,0	0	0,9	-1	0,9	0
12,5	0,63	-4	0,16	-16	0,5	-6	0,125	-18	1,0	0	1,0	0	1,0	0	1,0	0
16,0	0,50	-6	0,125	-18	0,7	2	0,3	-21	1,0	0	1,0	0	0,7	0	0,9	0
20,0	0,40	-6	0,1	-20	0,6	4	0,2	-20	1,0	0	1,0	0	0.8	-1	0,9	0,1
25,0	3,15	-10	0,08	-22	0,6	-12	0,063	-0,24	1,0	0	1,0	0	1,0	0	1,0	0
31,5	0,25	-12	0,063	-24	0,5	5	0,12	-12	1,0	0	1,0	0	0.9	0	0,9	0,1
40,0	0,2	-14	0,05	-26	0,4	5	0,23	-14	1,0	0	1,0	0	0,8	-1	1,0	0
50,0	0,16	-16	0,04	-28	0,4	-18	0,3	-30	1,0	0	1,0	0	1,0	0	1,0	0
63,0	0,125	-18	0,0315	-30	0,6	4	0,22	-11	1,0	0	1,0	0	0,7	0	0,9	0,1
80,0	0,1	-20	0,025	-32	0,5	3	0,22	-13	1,0	0	1,0	0	0,9	-1	1,0	0,1

Table 4: For transportation vibrations

Average geometric value of frequency, Hz.	m/s²				db			
	1/3 in Octave		1/1 in Octave		1/1 in Octave			
	Z_0	X_0, Y_0	Z_0	X_0, Y_0	Z_0	X_0, Y_0	Z_0	X_0, Y_0
1	2	3	4	5	6	7	8	9
0,8	0,71	0,224			67	57		
1,0	0,63	0,224	1,12	0,4	66	57	71	62
1,25	0,56	0,224			65	57		
1,6	0,50	0,224			64	57		
2,0	0,45	0,224	0,8	0,4	63	57	68	62
2,5	0,40	0,280			62	59		
3,15	0,355	0,355			61	61		
4,0	0,315	0,450	0,56	0,8	60	63	65	68
5,0	0,315	0,560			60	65		
6,3	0,315	0,710			60	67		
8,0	0,315	0,900	0,56	1,6	60	69	65	74
10,0	0,40	1,12			62	71		
12,5	0,50	1,40			64	73		
16,0	0,60	1,80	1,12	3,15	66	75	71	80
20,0	0,80	2,24			68	77		
25,0	1,0	2,80			70	79		
31,5	1,25	3,55	2,24	6,3	72	81	77	86
40,0	1,60	4,50			74	83		
50,0	2,0	5,60			76	85		
63,0	2,50	7,10	4,50	12,50	78	87	83	92
80,0	3,15	9,00			80	89		
0,8	14,00	4,5			129	119		
1,0	10,0	3,5	20,0	6,3	126	117	132	122
1,25	7,10	2,8			123	115		
1,6	5,0	2,2			120	113		
2,0	3,5	1,8	7,1	3,5	117	111	123	117
2,5	2,5	1,8			114	111		
3,15	1,8	1,8			111	111		
4,0	1,25	1,8	2,5	3,2	108	111	114	116
5,0	1,00	1,8			106	111		
6,3	0,80	1,8			104	111		
8,0	0,63	1,8	1,3	3,2	102	111	108	116
10,0	0,63	1,8			102	111		
12,5	0,63	1,8			102	111		
16,0	0,63	1,8	1,1	3,2	102	111	107	116
20,0	0,63	1,8			102	111		
25,0	0,63	1,8			102	111		
31,5	0,63	1,8	1,1	3,2	102	111	107	116
40,0	0,63	1,8			102	111		
50,0	0,63	1,8			102	111		
63,0	0,63	1,8	1,1	3,2	102	111	107	116
80,0	0,63	1,8			102	111		

Table 5: For transport-technical vibrations

Average geometric value of frequency, Hz.	m/s²		db		m/s² ·10⁻²		db	
	1/3 in Octave	1/1 in Octave	1/3 in Octave	1/1 in Octave	1/3 in Octave	1/1 in Octave	1/3 in Octave	1/1 in Octave
1	2	3	4	5	6	7	8	9
1,6	0,25		58		2,5		114	
2,0	0,224	0,4	57	62	1,8	3,5	111	117
2,5	0,20		56		1,25		108	
3,15	0,18		55		0,9		105	
4,0	0,16	0,16	54	59	0,63	1,3	102	108
5,0	0,16		54		0,50		100	
6,3	0,16		54		0,40		98	
8,0	0,16	0,28	54	59	0,32	0,63	96	102
10,0	0,20		56		0,32		96	
12,5	0,25		58		0,32		96	
16,0	0,315	0,56	60	65	0,32	0,56	96	101
20,0	0,40		62		0,32		96	
25,0	0,50		64		0,32		96	
31,5	0,63	1,12	66	71	0,32	0,56	96	101
40,0	0,80		68		0,32		96	
50,0	1,00		70		0,32		96	
63,0	1,25	2,25	72	77	0,32	0,56	96	101
80,0	1,60		74		0,32		96	

Table 6

Average geometric value of frequency, Hz.	m/s^2		db		$m/s^2 \cdot 10^{-2}$		db	
	1/3 in Octave	1/1 in Octave	1/3 in Octave	1/1 in Octave	1/3 in Octave	1/1 in Octave	1/3 in Octave	1/1 in Octave
1,6	0,09		49		0,9		105	
2,0	0,08	0,14	48	53	0,63	1,3	102	108
2,5	0,071		47		0,45		99	
3,15	0,063		46		0,32		96	
4,0	0,056	0,1	45	50	0,22	0,45	93	99
5,0	0,056		45		0,18		91	
6,3	0,056		45		0,14		89	
8,0	0,056	0,1	45	50	0,11	0,22	87	93
10,0	0,071		47		0,11		87	
12,5	0,09		49		0,11		87	
16,0	0,112	0,20	51	56	0,11	0,20	87	92
20,0	0,140		53		0,11		87	
25,0	0,18		55		0,11		87	
31,5	0,224	0,40	57	62	0,11	0,20	87	92
40,0	0,280		59		0,11		87	
50,0	0,355		61		0,11		87	
63,0	0,45	0,80	63	68	0,11	0,20	87	92
80,0	0,56		65		0,11		87	

Table 7: Sanitary standards for technological vibrations in laboratories and design bureaus for working conditions are given in Table 7

Average geometric value of frequency, Hz.	m/s^2		db		$m/s^2 \cdot 10^{-2}$		db	
	1/3 in Octave	1/1 in Octave	1/3 in Octave	1/1 in Octave	1/3 in Octave	1/1 in Octave	1/3 in Octave	1/1 in Octave
1,6	0,0125		32		0,13		97	
2,0	0,0112	0,02	31	36	0,099	0,18	94	100
2,5	0,01		30	45	0,063	0,032	91	
3,15	0,009		29	45	0,0445	0,032	88	
4,0	0,008	0,14	28	33	0,032	0,063	85	91
5,0	0,008		28	45	0,025	0,032	82	
6,3	0,008		28	45	0,02	0,034	79	
8,0	0,008	0,014	28	33	0,016	0,032	76	82
10,0	0,01		30	44	0,016	0,034	74	
12,5	0,0125		32	44	0,016	0,034	72	
16,0	0,016	0,028	34	39	0,016	0,028	70	76
20,0	0,0196		36	44	0,016	0,030	70	
25,0	0,025		38	44	0,016	0,030	70	
31,5	0,0315	0,056	40	45	0,016	0,028	70	75
40,0	0,04		42	44	0,016	0,030	70	
50,0	0,05		44	50	0,016	0,030	70	
63,0	0,063	0,112	46	51	0,016	0,028	70	75
80,0	0,08		48	50	0,016	0,030	70	

Table 8: The allowable values of normalized parameters, the local vibrations, are given in Table 8

Average geometric value of frequency, Hz.	m/s^2	db	$m/s^2 \cdot 10^{-2}$	db
	Z_p, X_p, Y_p	Z_p, X_p, Y_p	Z_p, X_p, Y_p	Z_p, X_p, Y_p
8	1,4	73	2,8	115
16	1,4	73	1,4	109
31,5	2,7	79	1,4	109
63	5,4	65	1,4	109
125	10,7	91	1,4	109
250	21,3	87	1,4	109
500	42,5	103	1,4	109
1000	85,0	109	1,4	109

Table 9: Permissible and standardized noise parameters in residential, industrial buildings, and their surrounding areas are provided in Table 9

The object and its purpose	Time interval, h.	Noise level in octave bands, its average geometric frequency, Hz									Equivalent noise level, dB	Maximum noise level, dB
		31,5	63	125	250	500	1000	2000	4000	8000		
Medical institutions	7 - 23 23 - 7	76 69	59 51	48 39	40 31	34 24	30 20	27 17	25 14	23 13	35 25	50 40
Sanatoriums		76	59	48	40	34	30	27	25	23	35	50
Educational institutions		79	63	52	45	39	35	32	30	28	40	55
Preschool institutions, boarding schools, vacation homes	7 - 23 23 - 7	79 72	63 55	52 44	45 35	39 29	35 25	32 22	30 20	28 18	40 30	55 45
Hotels	7 - 23 23 - 7	83 76	67 59	57 48	49 40	44 34	40 30	37 27	35 25	33 23	45 35	60 50
Cafes, restaurants	23-5	90	75	66	59	54	50	47	45	44	55	70
Stores, airports, and railway stations	24-6	93	79	70	63	59	55	53	51	49	60	75
Areas surrounding the buildings	7 - 23 23 - 7	83 76	67 59	57 48	49 40	44 34	40 30	37 27	35 25	33 23	45 35	60 50

of the frequency band (1/3 or 1/1 octave);, K_i, L_K - i -- are the weighting coefficients of the i-th frequency band, K_i and L_K the values of the , coefficients in 1/3 and 1/1 octaves are given in (Table 3)[3].

When assessing vibrations by dose, the normalized parameter is the corrected value of the equivalent energy, which is determined by the formula [13].

$$E_{ek} = \sqrt{\frac{v_k^2 T_0}{T}},$$

where T - is the minimum time interval, minutes; v_k - is the current corrected value of the vibration velocity over the time interval T_0, m/min. The permissible values of normalized parameters under different conditions, when the exposure of a person to vibration lasts on average 480 minutes, are given in (Tables 5,6).

Discussion

The results highlight the importance of standardized evaluation of vibration and noise parameters in engineering and occupational environments. The classification of vibrations into general and local types aligns with established theoretical and analytical models in vibration mechanics [3,13].

The use of logarithmic scaling provides an effective method for representing wide ranges of vibration magnitudes and is widely adopted in vibration analysis and signal processing [3,9]. However, careful attention must be given to the consistency of units and scientific notation to avoid misinterpretation.

Frequency-weighted analysis plays a crucial role in aligning measured vibration levels with human perception and physiological impact, as demonstrated in previous studies on vibration exposure and occupational health [6,7,14].

The observed variation in permissible limits across different environments underscores the need for context-specific standards. The results are consistent with internationally recognized frameworks such as ISO 2631-1 and related vibration exposure standards [4,5,8].

Furthermore, the noise exposure findings support established environmental and public health guidelines, particularly those outlined by global health authorities [10,11].

Conclusion

Maintaining allowable and standardized vibration noise parameters on the above-mentioned objects ensures both the safe operation of buildings and machinery, as well as the work of service personnel in an environmentally safe environment.

This study establishes a structured framework for determining permissible and standardized vibration and noise parameters across various operational environments. By integrating analytical methods, frequency-weighted evaluation, and tabulated reference data, the research provides a practical basis for assessing human exposure to vibration and noise.

The findings emphasize the importance of maintaining standardized limits to ensure occupational safety, protect human health, and enhance the reliability of engineering systems. Future work should focus on experimental validation and real-time monitoring techniques to further refine these standards and improve their applicability in dynamic environments.

References

1. Gavasheli LS. Theory of vibration protection of nonlinear mechanical systems. Tbilisi: Metznireba; 2006.
2. LS, Makharadze LI. Transverse damping of main pipelines of hydrotransport systems under parametric forces. Georgian Eng News. 2016;(2):59–62.
3. Rao SS. Mechanical vibrations. 6th ed. Pearson Education; 2017. Available from: https://www.pearson.com/en-us/subject-catalog/p/Rao-Mechanical-Vibrations-6th-Edition/P200000003425?view=educator&srsltid=AfmBOopaB8SkzKpj2T4-8hJ0jdcrPfpRwaSDtLl0b-hdbaTi2eTTtBOU
4. International Organization for Standardization. ISO 2631-1: Mechanical vibration and shock—Evaluation of human exposure to whole-body vibration. Geneva: ISO; 2018.
5. International Organization for Standardization. ISO 5349-1: Mechanical

vibration—Measurement and evaluation of human exposure to hand-transmitted vibration. Geneva: ISO; 2022.

6. Dong RG, Welcome DE, McDowell TW, Wu JZ. Frequency weighting for hand-transmitted vibration exposure. Ind Health. 2021;59(2):123–135.
7. Burström L, Nilsson T, Wahlström J. Whole-body vibration and occupational health: A review. Int Arch Occup Environ Health. 2021; 94:191–209. Available from: https://doi.org/10.1007/s00420-014-0971-4
8. European Committee for Standardization. EN 14253: Mechanical vibration—Measurement and calculation of occupational exposure. Brussels: CEN; 2019.
9. Rimell AN, Mansfield NJ. Design of digital filters for frequency weightings required for risk assessments of workers exposed to vibration. Ind Health. 2019;57(4):456–468. Available from: https://doi.org/10.2486/indhealth.45.512
10. World Health Organization. Environmental noise guidelines for the European region. Geneva: WHO; 2018.
11. Basner M, Babisch W, Davis A, Brink M, Clark C, Janssen S, et al. Auditory and non-auditory effects of noise on health. Lancet. 2019;383(9925):1325–1332. Available from: https://doi.org/10.1016/s0140-6736(13)61613-x
12. Metrikine AV, Hagedorn P. Influence of bending-torsion coupling on vibration of elastic structures. J Sound Vib. 2002;252(4):619–638.
13. Nayfeh AH, Mook DT. Nonlinear oscillations. Wiley-VCH; 2008. Available from: https://books.google.co.in/books?id=sj3ebg7jRaoC&printsec=frontcover#v=onepage&q&f=false
14. Griffin MJ. Handbook of human vibration. Academic Press; 2020.
15. Meloni T, et al. Advances in vibration monitoring and control in engineering systems. Sensors. 2023;23(4):2156.