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# INDUSTRIAL NOISE AND VIBRATION IN PRODUCTION. PROTECTIVE MEASURES.

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**Abstract**

This article provides comprehensive information on noise and vibration in industrial settings. It describes the negative impacts of noise and vibration on the human body, which can cause occupational diseases. It also provides detailed information on noise control, vibration control, and vibration isolation for equipment.

**Keywords**

noise, vibration, ventilation devices, sound level meter, earmuffs, diseases, antiphonal

## Introduction

Noise and vibration are the vibrations of material particles in gases, liquids, and solids. In the chemical industry, certain production processes are accompanied by significant noise, vibration, and shock. Sources include crushers, mills, engines, transport and ventilation devices (gas blowers), high-velocity gas and liquid flows, and others.

In plastics and rubber processing plants, noise is generated by crushing defective parts, grinding, cleaning parts in a drum, and by the operation of engines, compressors, pumps, ventilation systems, machine mechanisms, etc.

Noise, vibration, and shock have a negative impact on the human body and can cause occupational diseases.

Oscillations with a frequency of 16 to 20,000 Hz are perceived by the human auditory analyzer as sound.

Noise is a disordered combination of sounds consisting of a large number of tones of different frequencies. and strength. The effect of noise depends on the strength, frequency, duration, and regularity of the sound. There are low (<300 Hz), medium (>300 Hz), and high (>800 Hz) frequency noises.

Noise level (erg/cm$^2$ sec ) is determined by the amount of sound energy (erg) and the pressure caused by the air wave (bar).

The sound intensity is characterized by the established

logarithmic scale of sound level or sound pressure in decibels ( dB )

$L = 10 \lg {}^{J}/_{Jo} = 20 \lg {}^{P}/_{Po}$ $L = 10 \lg {}^{J}/_{10^{-14}} = 20 \lg {}^{P}/_{2 \times 10^{-5}}$

For this purpose, there is a scale up to 140 dB, where the sound power

( $l_0 = 10^{-14}$ H \cm $^2$

erg/cm $^2$ sec) is taken as the initial value, which corresponds to the threshold of hearing of sound with a frequency of 1000 Hz.

The pain threshold is determined at a sound intensity of $l_0 = 10^{-14}$ erg/cm sec. (210 $^{-5}$ Pa)

In addition to the sound level, the concept of loudness level, defined by the unit phon, has been introduced. This takes into account the varying sensitivity of human hearing to sounds of different frequencies.

A change in volume level by 1 phon is barely noticeable, while a change by 8-10 phons is perceived as a change in noise volume by 2 times.

A sound with a volume level of 40 phons corresponds to a whisper, 70-75 phons to conversational speech, 85 phons and above already has a harmful effect on the body. and depends on the frequency of vibrations.
For each sound within the frequency range of sound vibrations perceived by the auditory organ, there are limits to the intensity of sound. The minimum is at the threshold of audibility; the maximum is at the threshold of touch, at which any further increase in sound is perceived as pain.

Harmful effects of noise lead to hearing fatigue, noise trauma and occupational hearing loss.

1) Hearing fatigue is explained by acute fatigue of the cells of the cortical part of the ear and is the cause of the development of occupational hearing loss.

2) Noise trauma occurs as a result of exposure to high sound pressure (blasting operations, testing of powerful motors), where dizziness, noise, ear pain, and damage to the eardrum are observed.

3) Occupational hearing loss leads to hearing loss up to and including complete hearing loss.

Vibration is the oscillation of elastic bodies, apparatus, machines, communications, platforms, structures, observed during improper balancing of machine shafts, transportation of liquids and gases, etc. (frequency up to 16 Hz ). Vibration and shock cause damage to the strength and integrity of equipment, communications, and various accidents. It is measured in units of pallets and dB. The interval from the perception threshold (0.5 pallets) to the pain threshold of 70 pallets is divided by 70 pallets.

When exposed to high-intensity vibrations, the body causes changes in the nervous and cardiovascular systems. The musculoskeletal system, gastrointestinal tract, balance organs, and others. The effects of vibration depend on frequency, speed, acceleration, and duration of oscillation. Symptoms of harmful vibration include dizziness, headache, visual disturbances, increased body temperature, and, when working with pneumatics, finger numbness, hand neuroses, joint pain, and increased blood pressure.

P = V /2PA, \ W =4P $^2$ P $^2$ A m/sec $^{2,}$ V =2P F A m/sec.

The dependence of the biological effect of vibrations on the body on their frequency

and amplitude of oscillations

| frequency, GC. | Amplitude of vibration oscillations, mm. | Influence on the body |
|---|---|---|
| Various | up to 0.015 | There is no pathological change. |
| 40-50 | 0.016-0.05 | Nervous excitement with depression. |
| 40-50 | 0.05-0.10 | Changes in the central nervous system, vascular organs of hearing. |
| 40-50 | 0.10-1.3 | Formation of stagnant centers of excitation in the body, development of vibration disease. |
| 50-100 | 0.1-1.30 | Significant changes in the central nervous system, heart, hearing organs. The occurrence of vibration disease. |

Maximum permissible values (MPE) of vibrations in workplaces and industrial premises

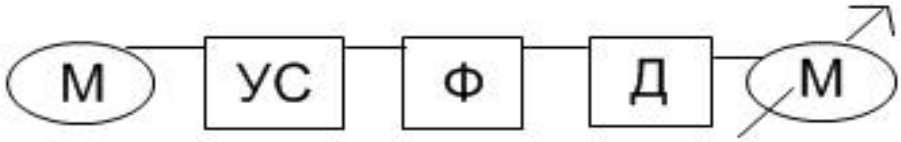
| Frequency, Hz | Oscillation amplitude, mm | Speed of oscillatory movements, cm/sec | Acceleration of oscillatory movements, cm/sec |
|---|---|---|---|
| doseZ | 0.6-0.4 | 1.12-0.76 | 22-14 |
| 3-5 | 0.4-0.15 | 0.76-0.46 | 14-15 |
| 5-8 | 0.15-0.05 | 0.46-0.25 | 15-13 |
| 8-15 | 0.05-0.03 | 0.25-0.28 | 13-27 |
| 15-70 | 0.03-0.009 | 0.28-0.17 | 27-32 |
| 30-50 | 0.009-0.007 | 0.17-0.22 | 32-70 |
| 50-75 | 0.007-0.005 | 0.22-0.23 | 70-112 |
| 75-100 | 0.005-0.003 | 0.23-0.19 | 112-130 |

When the vibration frequency exceeds 35 Hz, disturbances in the body's vascular system (vasoconstriction) increase sharply.

VShV-003, VVM) are used to measure noise and vibration. These devices operate by converting sound energy into electrical energy.

To measure sound levels, objective sound level meters are used:

Block diagram of an objective sound level meter.




M - measuring microphone; US - amplifier; F - filter

corrections;

D - square-law detector; I - indicator device.

Noise spectrum analyzers (PF-1) are also used in conjunction with these devices. A handheld vibrograph (VR-1) records vibrations with an amplitude of 0.05+5 mm and a frequency of 5-100 Hz.

Combating noise and vibration.

To combat noise and vibration, preventive measures are taken during the design, planning, and construction of facilities: - selection of silent press equipment;

- use of sound-absorbing, sound-summing and vibration-summing materials;

- placement of noisy workshops and individual units in separate rooms and operational measures.

Where it is impossible to reduce noise level up to the level permitted by sanitary standards (compressors, crushers, gas blowers). So

organizational, technical, and hygienic measures are used to reduce negative noise. Of these, the most effective are

- placement of control panels in soundproofed premises;

- installation of soundproof ventilated booths in the department, in the workshop with monitoring of work using instruments;

- a short break in work where there is no noise.

To reduce vibration of parts and assemblies, elastic gaskets and springs are used, and metal parts are replaced with plastic ones.

During the manufacturing and assembly of machines and components, traction balancing is performed, reducing clearances. Rolling bearings are replaced with plain bearings.

In small rooms where fan noise is 50-60 dB, fans with a higher speed should be installed outside or in special chambers with good sound insulation. When operating fans, ejectors, and blowers, it is necessary to ensure that the air or gas flow velocity around the components is up to 30 m/sec. Cross-sections and bends in gas and air ducts are reinforced.

To prevent diseases from exposure to noise, personal protective equipment - noise suppressors - are used :

1) antiphons inserted into the ear canals

2) earmuffs (headbands, helmets) that cover the ears from the outside are used when technical noise control methods fail to reduce noise to acceptable levels. Workers must undergo a preliminary medical examination before being allowed to work in noisy areas. Exposure to noise in noisy areas can cause general and partial hearing loss, chronic purulent eardrum diseases, inner ear sclerosis, and central nervous system disorders.

Vibration isolation protection of equipment

When operating most production equipment Noise and vibration are observed, which worsen working conditions. Therefore, to eliminate noise and vibration, insulation made of elastic materials—wood, rubber buffers, springs, and springs—is used between the machine and its supporting base. The following measures are also necessary to create effective vibration isolation:

1) balance moving parts of machines as much as possible;

2) eliminate rigid connections between the machine and its supporting base;

3) separate the fundamental block of the suspension machine from surrounding objects with an air gap and secure the machine to the block;

4) when installing machines, transfer their center of gravity to the line of the center of gravity of the total area of elastic supports for creating a uniform static load on elastic bodies.

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