# HIGH PRESSURE LEVEL OF PRODUCTION NOISE AND ITS EFFECT ON THE HUMAN BODY

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**Annotation:** This article provides a comprehensive scientific analysis of high-pressure levels of industrial noise and their negative impact on the human body. It is noted that the impact of noise on the body depends, first of all, on its intensity, frequency composition and duration, as well as on the working conditions, age, and health status of the worker. Studies have shown that noise not only affects the hearing organs but also damages the central nervous system, cardiovascular system, digestive organs, and other vital organs. Insufficient differentiation of speech against the background of noise creates an additional load on the human psyche. It has also been shown that the influence of sound vibrations through bone conduction through the skull leads to excessive negative consequences for the human body. The article covers the risk of impulse and uneven noise, a complex of clinical signs of noise sickness, including hearing loss, cardiovascular insufficiency, and central nervous system dysfunction. The properties of infrasound are also considered separately, and the dangerous consequences arising when the resonant frequencies of the internal organs of a person correspond to them, including the feeling of pain and even the possibility of organ rupture, are described on a scientific basis. The influence of ultrasound on the human body through air, liquid, and solid media is also shown. Specific (cochlear) and non-specific (extracochlear) effects were compared, and various mechanisms of action of low- and high-frequency noise were analyzed. Based on the gradations developed according to Kuralesin, the risk zones for noise and their subjective and objective characteristics are presented in the table. The research results show that noise in the production environment in the range of 90-140 dB poses a serious threat to human health. Therefore, the article substantiates the necessity of using personal protective equipment and designing special noise protection systems.

**Keywords:** production noise, high-pressure noise, impact on the human body, hearing impairment, central nervous system, cardiovascular system, noise sickness, infrasound, ultrasound, sanitary and hygienic standards, protective equipment.

**Annotatsiya**: ushbu maqolada sanoat shovqinining yuqori bosim darajasi va ularning inson organizmiga salbiy ta'siri har tomonlama ilmiy tahlil qilingan. Ta'kidlanishicha, shovqinning tanaga ta'siri, birinchi navbatda, uning intensivligi, chastota tarkibi va davomiyligiga, shuningdek ishchining ish sharoitlari, yoshi va



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sog'lig'iga bog'liq. Tadqiqotlar shuni ko'rsatdiki, shovqin nafaqat eshitish organlariga ta'sir qiladi, balki Markaziy asab tizimi, yurak-qon tomir tizimi, ovqat hazm qilish organlari va boshqa muhim organlarga ham zarar etkazadi. Shovqin fonida nutqning etarli darajada farqlanmasligi inson psixikasiga qo'shimcha yuk yaratadi. Shuningdek, bosh suyagi orqali suyak o'tkazuvchanligi orqali tovush tebranishlarining ta'siri inson tanasi uchun haddan tashqari salbiy oqibatlarga olib kelishi ko'rsatilgan. Maqolada impuls va notekis shovqin xavfi, shovqin kasalligining klinik belgilari majmuasi, jumladan eshitish qobiliyatini yo'qotish, yurak-qon tomir etishmovchiligi va Markaziy asab tizimining disfunktsiyasi yoritilgan. Infratovushning xususiyatlari ham alohida ko'rib chiqiladi va inson ichki organlarining rezonans chastotalari ularga mos kelganda yuzaga keladigan xavfli oqibatlar, shu jumladan og'riq hissi va hatto organlarning yorilishi ehtimoli ilmiy asosda tavsiflanadi. Ultratovushning inson tanasiga havo, suyuqlik va qattiq muhit orqali ta'siri ham ko'rsatilgan. Maxsus (Koklear) va o'ziga xos bo'lmagan (ekstrakoklear) effektlar taqqoslandi, past va yuqori chastotali shovqinlarning turli xil ta'sir mexanizmlari tahlil qilindi. Kuralesin bo'yicha ishlab chiqilgan gradatsiyalarga asoslanib, shovqin uchun xavf zonalari va ularning sub'ektiv va ob'ektiv xususiyatlari jadvalda keltirilgan. Tadqiqot natijalari shuni ko'rsatadiki, ishlab chiqarish muhitida 90-140 dB oralig'idagi shovqin inson salomatligiga jiddiy xavf tug'diradi. Shuning uchun maqolada shaxsiy himoya vositalaridan foydalanish va shovqindan himoya qilishning maxsus tizimlarini loyihalash zarurligi asoslanadi.

**Kalit so'zlar:** ishlab chiqarish shovqini, yuqori bosimli shovqin, inson organizmiga ta'siri, eshitish qobiliyati, Markaziy asab tizimi, yurak-qon tomir tizimi, shovqin kasalligi, infratovush, ultratovush, sanitariya-gigiyena me'yorlari, himoya vositalari.

**Аннотация**: В данной статье представлен всесторонний научный анализ высоких уровней промышленного шума и их негативного воздействия на организм человека. Отмечается, что воздействие шума на организм зависит, прежде всего, от его интенсивности, частотного состава и продолжительности, а также от условий труда, возраста и состояния здоровья работника. Исследования показали, что шум влияет не только на органы слуха, но и на центральную нервную систему, сердечно-сосудистую систему, органы пищеварения и другие жизненно важные органы. Недостаточная дифференцированность речи на фоне шума создает дополнительную нагрузку на психику человека. Также было показано, что воздействие звуковых колебаний посредством костной проводимости через череп приводит к чрезмерным негативным последствиям для организма человека. В статье рассматривается риск импульсного и неравномерного шума, комплекс клинических признаков шумовой болезни, включая потерю слуха, сердечно-



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сосудистую недостаточность и дисфункцию центральной нервной системы. Отдельно также рассматриваются свойства инфразвука, и на научной основе описываются опасные последствия, возникающие при соответствии им резонансных частот внутренних органов человека, включая ощущение боли и даже возможность разрыва органа. Также показано влияние ультразвука на организм человека через воздух, жидкость и твердые среды. Сравнивались специфические (кохлеарные) и неспецифические (экстракохлеарные) эффекты, а также анализировались различные механизмы воздействия низкочастотного и высокочастотного шума. На основе градаций, разработанных в соответствии с Куралесиным, в таблице представлены зоны риска для шума и их субъективные и объективные характеристики. Результаты исследований показывают, что шум в производственной среде в диапазоне 90-140 дБ представляет серьезную угрозу для здоровья человека. Поэтому в статье обосновывается необходимость использования средств индивидуальной защиты и проектирования специальных систем защиты от шума.

**Ключевые слова:** производственный шум, шум высокого давления, воздействие на организм человека, нарушение слуха, центральная нервная система, сердечно-сосудистая система, шумовая болезнь, инфразвук, ультразвук, санитарно-гигиенические нормы, средства защиты.

**Introduction.**

The impact of noise on the human body depends, first of all, on its intensity, frequency composition and duration of exposure, as well as on the location of the person and the type of work performed1. The impact of industrial noise manifests itself differently among people and depends mainly on age, health status, type of work, and physical and mental state. Often, the noise created by the person himself does not have a noticeable effect on him, but external noise causes strong anxiety[2]. The impact of noise on the human body is exacerbated by forced posture, high levels of concentration, neuro-emotional stress, unfavorable microclimate, and vibration. The louder the noise and the longer the duration of its effect on the body, the more serious functional disorders occur[3], [36-38].

**LITERATURE ANALYSIS AND METHODS.** One of the factors negatively affecting the human psyche is insufficient differentiation of speech in noisy production conditions. The range of sounds perceived by humans is limited by frequencies (from 20 to 20,000 Hz) and threshold values of sound pressure. The scope of human hearing is clearly shown in Figure 1[5].



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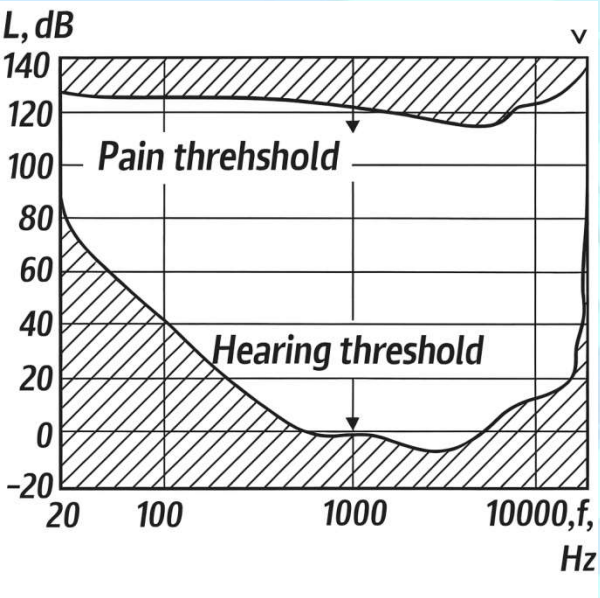



**Figure 1 - Human hearing**

A lot of data has been collected that allows us to conclude about the influence of noise on auditory function. As a result of the constant impact of noise on the hearing organ, fatigue occurs, and due to the daily repetition of this process, the restoration of hearing ability is incomplete upon the next exposure to noise. As a result, excessive fatigue occurs, which over time can lead to deafness.

However, it has been established that noise negatively affects not only the hearing organ, but also many organs and systems of the body, primarily the central nervous system. Functional changes in the central nervous system occur before the detection of hearing impairment[9]. Sound vibrations can be perceived not only through the ear, but also directly through the bones of the skull (this process is called "bone conduction"). The noise level transmitted in this way is 20...30 dB lower than the level perceived by the ear. At low levels, transmission through bone conduction is insignificant, at high levels it increases significantly and intensifies the negative impact on the human body[13, 5]. With impulse and non-uniform (irregular) noise, the degree of noise impact increases. Its effectiveness is mainly closely related to the fact that the impulse level is higher than the level that determines the background noise at the workplace. Standardized noise background values and their exceedances at workplaces are regulated by sanitary standards. [14-16]. Pathological changes caused by noise are considered "noise sickness." Currently, "noise sickness" in medical science is characterized by a complex of symptoms. These include decreased auditory sensitivity, impaired digestive system functions (decreased acidity), cardiovascular insufficiency, and functional disorders of the central nervous system. [13, 46-67]. The results of the negative impact of noise in the audible range are presented in Fig. 2.



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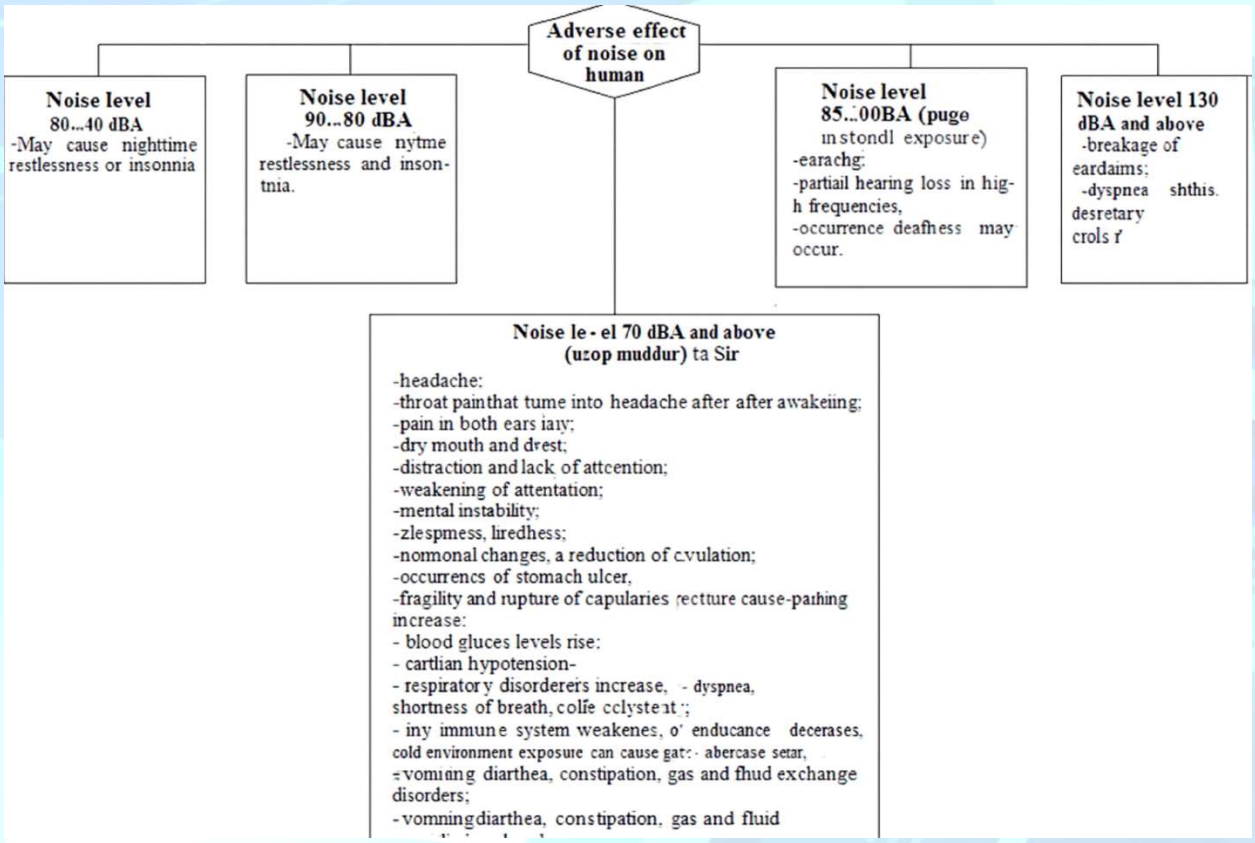


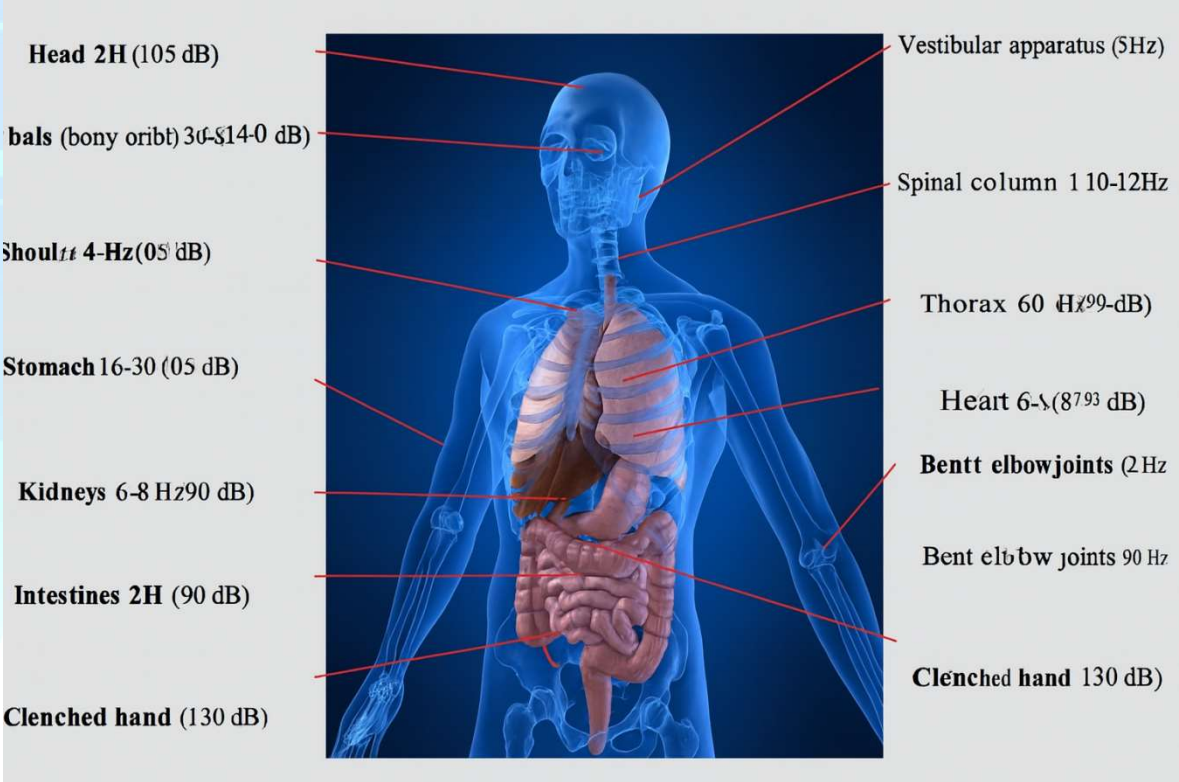

**Figure 2 Negative effects of noise on the human body.**

Machines and mechanisms with large-sized surfaces, performing low-frequency mechanical oscillations, as well as turbulent flows of gases and liquids, are the main sources of infrasound in industry[18-22]. Because infrasound frequencies are below the hearing threshold, they are imperceptible to the human ear. However, this does not mean that infrasound does not have a negative impact on the human body[23].

**RESULTS.** Infrasound has greater penetrating power compared to noise perceived by the ear [24-25], the greatest danger lies in the fact that the frequency of infrasound coincides with the frequency of the internal organs of a person and can lead to disruptions in their function[27]. It is known [26], that the internal organs of a person have their own frequencies (Fig. 3) [4,30].



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**Resonance frequencies of acoustic vibrations that cause pathological changes when exposed to various organs of the body for a long time (*Acoustic vibrations in which resonance phenomena are observed in parentheses, dB (for a wide frequency spectrum).**

When the sound frequency and the frequency of oscillations of the internal organs coincide, resonance phenomena occur, a feeling of pain arises, and at some values of the frequency and an increased value of the sound power, internal organs can rupture [31,32,33]. Thus, the influence of resonant frequencies, even at a relatively low noise level of 50-80 dB, can lead to harmful consequences for health, and with damage to vital organs - to death. The results of the negative impact of infrasound on the human body are presented in Figure 4.



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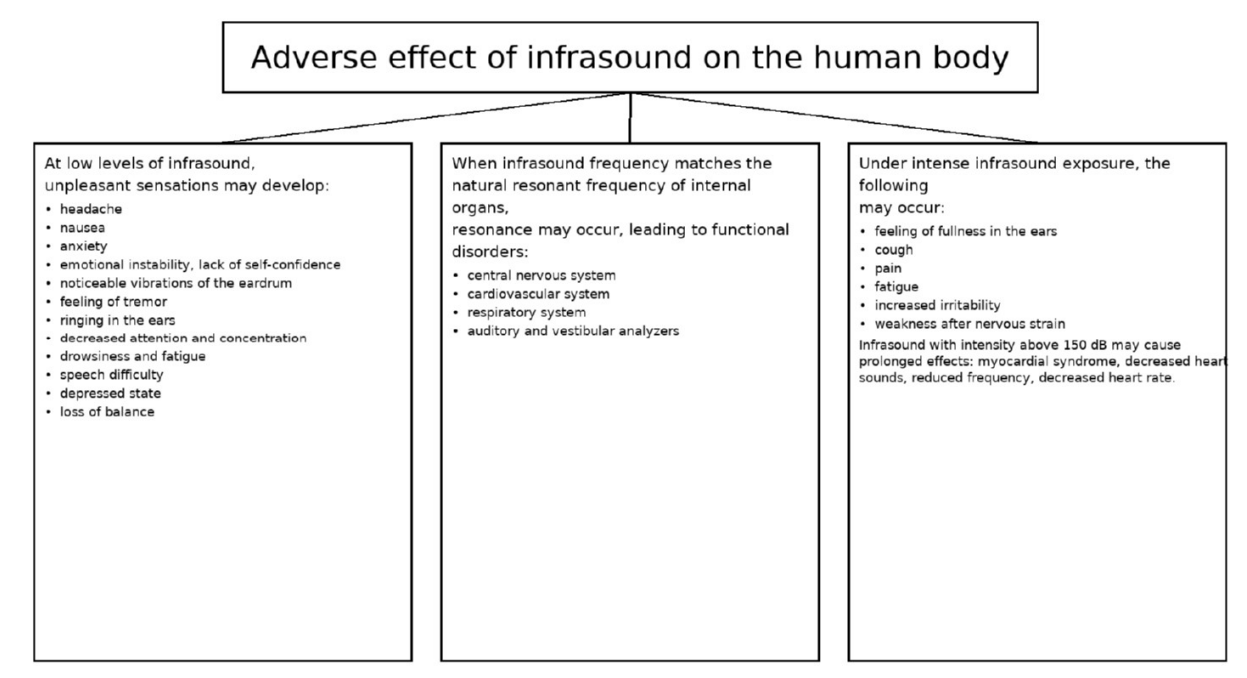



**Figure 4 - Negative effects of infrasound on the human body**

Ultrasonic vibrations can affect a person both through the air environment and through contact (to the hands) through liquid and solid media. The negative impact of ultrasound on the human body is shown in Figure 5.

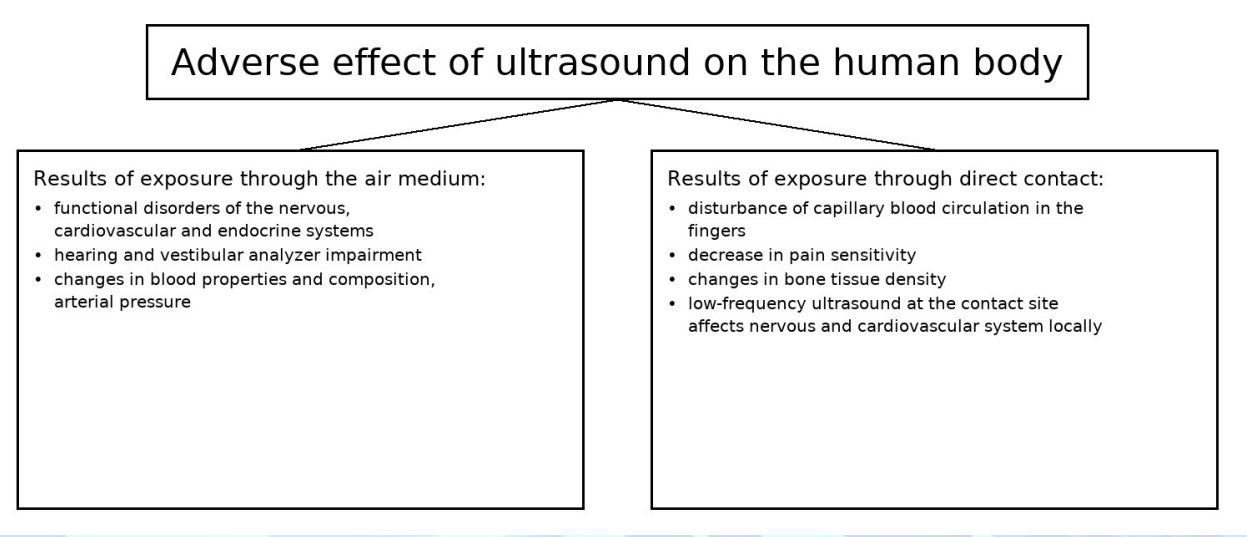



**Figure 5 - Negative effects of ultrasound on humans**

It is known that the impact of noise on the human body is divided into specific and non-specific types. The specific (cochlear) effect belongs to the high- and medium-frequency noise range and mainly affects the nervous system and hearing organs. The non-specific (extracochlear) effect covers the low-frequency range. In this case, infrasound acts through mechanoreceptors, often affecting the cardiovascular system and internal organs of the human body [19-20]. The main objective and subjective features of the impact of noise on the human body according to Kuralesin are presented in Table 1.



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**Table 1**

**Signs of noise exposure according to Kuralesin [19]**

| No. | Gradation of human exposure to noise | Noise level, dB | Signs of the impact of noise on the human body |
|---|---|---|---|
| 1. | 2. | 3. | 4. |
| 1. | Mortality zone | 180-190 dB | Lethal effect - rupture of lung alveoli |
| 2. | Extreme effect zone | 0-20 Hz, above 140-150 dB | Pressure sensation in middle ear |
| | | 50-100 Hz above 154 dB for 2 minutes | Headache, shortness of breath, cough, blurred vision, fatigue, strong pressure behind the chest, salivation, swallowing pain. These are the indicators of the endurance limit. |
| | | 100 Hz discrete frequencies 153 dB 2min | Nausea, dizziness, discomfort and redness of the skin. Cough, very strong pressure behind the chest. |
| | | 60 Hz 157 dB 2min | Suffocation, salivation, pain when swallowing, dizziness. |
| | | 73 Hz 150 dB 2min | Feeling chest vibration, dry mouth, changes in breathing rhythm, general weakness; unreal deceptive sensations. |
| | | 0-150 Hz to 145 dB for 2 minutes | Below voluntary endurance limit |
| 3. | High-risk zone for health, even with periodic exposure | 1-20 Hz 140-145 dB | During the operation of jet engines, the chest and abdominal cavity of employees are shaken, a state resembling seasickness occurs, and vestibular disorders develop: statokinetic, sensory dizziness, vegetative-nausea. Prolonged exposure leads to asthenia, general weakness, decreased mental capacity, irritability, sleep disturbances, and in some cases, |



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| | | | |
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| | | | mental disorders due to anxiety and worry. |
| 4. | High risk zone for health in short exposure | 2,4,8,16 Hz 134,129,126,123 dB-15 min<br><br>10 Hz 135 dB 15 min | Subjective sensory-somatovegetative discomfort: nausea, dizziness, pressure and massage of the tympanic membranes, tinnitus, trembling tremor, "movement" in the intestinal and gastric regions; chest, temporal pain, headache, feeling of heaviness in the occipital region, eye pain. Feeling of restlessness, salivation with liquid saliva, etc.<br>A sharply expressed state of infrasonic sensory-somatovegetative discomfort: headache, heaviness in the head, dizziness, vibration and pressure of the tympanic membrane, feeling of vibration of internal organs, dry mouth, difficulty breathing. |
| 5. | Zone of significantly increased health risk | 110-120 dB<br><br>2,4,8,16 Hz, 115dB 1-5 h | Effects lasting no more than a few minutes are not harmful to health. With longer-term effects, long-term effects can be formed by the vestibular and auditory analyzers.<br><br>Drowsiness, headache, body vibration sensation |
| 6. | Moderate risk zone | 16Hz 105 dB 1 hour<br>8.16Hz,100 dB 1 hr<br>90-100 dB<br><br>less than 90 dB | Dizziness, drowsiness, irritability<br>Complaints of throat itching, cough, tinnitus and pain, weakness, drowsiness, absent-mindedness<br>Short-term effects are harmless to health, but prolonged exposure may cause complaints, discomfort, and other symptoms. In addition, a significant increase in cases of spontaneous abortion (miscarriage) (up to 11-17%) and |



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| | | | pregnancy complications (up to 82%) can be observed.<br>The combined effect of noise-vibration factors, as well as neuro-emotional stress, can significantly exacerbate the negative impact (intensity of the workday, severity of work). |

As can be seen from the table, the impact of noise is extremely dangerous, and the most common disorders and diseases are associated with the impact not only on bone tissue, but also on the soft tissues of the human body. This leads to changes in the liver, vascular diseases, an increase in the number of leukocytes in the blood, venous congestion of acinar tissue, changes in lung tissue, kidneys, and myocardium.

**DISCUSSION.** As a result of the analysis of the impact of unfavorable noise on the human body, it was established that it is necessary to protect not only the head (helmet, headphones, earplugs), but also the internal organs of the body. Under the conditions of the type of production under consideration, as well as when analyzing the impact of noise on the enterprise's personnel from a medical point of view, noise in the range of 90-140 dB is considered a dangerous and harmful production factor [28-29]. Reducing the impact of this level of noise on a person through personal protective equipment is the main task of designing a special noise protection kit [11-21].

**CONCLUSION.** High-pressure noise levels are one of the most dangerous factors for human health in the production environment. The results of studies show that noises in the range of 90-140 dB cause serious damage not only to the hearing organ, but also to the central nervous system, cardiovascular system, and digestive organs. The resonance of infrasound and ultrasound with the internal organs of a person poses an additional danger, which can lead to pain, functional disorders, and even organ damage. The formation of noise sickness, decreased auditory sensitivity, and a complex picture of physiological changes further increase the relevance of this problem.

Therefore, it is important to introduce technical and organizational measures aimed at reducing noise in production, provide workers with personal protective equipment, and strictly comply with sanitary and hygienic standards. The obtained results serve as a scientific basis for a deeper understanding of the impact of noise on the human body, the identification of hazard zones, and the creation of effective protection systems in production.



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## REFERENCES

1. Ivanov, N. I. Engineering Acoustics. Theory and Practice of Noise Control: Textbook for Universities, for the direction "Life Safety" / N. I. Ivanov. Moscow: Logos, 2008. - 258 p.
2. Kolosov, Yu. V. Protection from Vibration and Noise in Production: Textbook / Yu. V. Kolosov, V. V. Baranovsky. - Тошкент, 2021. - 38 p.
3. Alekseev, S. V. On the question of the influence of solid-spectrum noise on some physiological functions of the body / S. V. Alekseev, G. A. Suvorov // Occupational Hygiene. - 1965. - No. 6. - P. 8-10.
4. Katsay, V. V. The Influence of Electrical Equipment Noise on the Electrotechnical Characteristics of the Human Body: diss. cand. tech. sciences: 14.01.05 / Katsay Victoria Vladimirovna. - Тошкент, 2020. - 109 p.
5. Yudin, E. Ya. Combating Production Noise: Handbook / E. Ya. Yudin, L. A. Borisov, I. V. Gorenstein, et al.; edited by E. Ya. Yudin. Moscow: Mashinostroyeniye, 1985. - 400 p.
6. Rukavishnikov, V. S. Determination of the functional state of the peripheral nervous system in patients with vibration sickness and occupational neurosensory congestion according to electroneuromyography indicators / V.S. Rukavishnikov, O.L. Lakhman, N.V. Kartapoltseva et al. // Medicine of Labor and Industrial Ecology. - 2008. - No 1. - P.10-17
7. Kartapoltseva, N. V. Assessment of clinical and functional changes in the nervous system under the influence of local vibration and noise on workers: diss. cand. medical sciences: 14.01.50 / Kartapoltseva Natalya Valerevna. - Тошкент, 2020. - 164 p.
8. Romanova, Yu. V. Immune status of persons employed in the production of building materials in the conditions of the Far North: diss. cand. biol. sciences 14.00.50 / Romanova Yulia Viktorovna. - Тошкент, 2020. - 140 p.
9. Zalaeva, S. Sh. Industrial Sanitation and Labor Hygiene. Part 1. Production Lighting. Vibration: textbook / S. Sh. Zalaeva, O. A. Rybka. - Belgorod: BGTU named after V.G. Shukhova, 2008. - 165 p.
10. Ricklefs, I. M. The state of functional systems of a person under the influence of noise and vibration and the possibilities of bioregulation by heart rate as a means of rehabilitation: abstract of diss.... cand. biol. sciences: 03.00.13/Ricklefs Irina Matveevna. - Тошкент, 2020. - 20 p.
11. Tsigayev A. L., Current Problems of Protecting the Human Operator from Production Vibrations and Noises/ Tsigayev A. L., - Kiev.: O-vo "Znaniye" USSR, 1981-254 p.



ISSN 3030-3907

12. Belov, S.V., Devyasilov, V.A., Kozyakov, A.F., et al. Life Safety Textbook for Secondary Specialized Educational Institutions / Under the general editorship of S.V. Belov. - 3rd ed., revised and supplemented. - M.: Higher School, 2003, - 357 p.
13. Andreeva-Galanina, E. S. Noise and Noise Disease / E. S. Andreeva-Galanina, S. V. Alekseev, A. V. Kadiskin, G. A. Suvorov. - L.: Medicine, 1970. - 304 p.
14. SN 2.2.4/2.1.8.562-96. Noise at workplaces, in the premises of residential and public buildings, and on the territory of residential buildings. Sanitary norms
15. Tarasova, L.A., Ostapkovich, V.E., Komleva, L.M., Lagutina, G.N., Clinical Aspects of Occupational Pathology from the Influence of Noise and Vibration./ L.A. Tarasova, V.E. Ostapkovich, L.M. Komleva, G.N. Lagutina -Ter. arch., 1988. Vol.60, 9. - 84-87 p.
16. Terekhov, A. L. Standardization of Gas Transport Equipment Noise in Russia and Abroad / A. L. Terekhov, M. N. Drobaxa. - M.: IRI Gazprom, 2007. - 89 p.
17. Tsyganov, V. I. The influence of vibration and noise on the capillaries of the brain: abstract of diss. cand. medical sciences: 14.00.23 / Tsyganov Vasily Ivanovich. Vladivostok, 1987. p. 21.
18. SN 2.2.4/2.1.8.583-96. Infrasound at workplaces, in residential and public premises, and on the territory of residential development. M.: Ministry of Health of Russia, 1997.
19. Kuralesin N.A. Scientific Basis of Regulation of Infrasound in Labor Medicine (Medical and Biological Aspects). Hygiene: dissertation of Doctor of Medical Sciences., 14.00.07/ Kuralesin, Nikolay Alekseevich, - Moscow 1997-227 p.
20. General regularities of the formation of nonspecific pathogenetic mechanisms under the influence of physical factors of the production environment on the body /V.S. Rukavishnikov, V.A. Pankov, N.V. Kartopolseva // Bulletin of the Higher Attestation Commission of the Republic of Uzbekistan. - 79-81 p.
21. Medvedev V. T., Ensuring the safety and comfort of human life by reducing the negative impact of vibration and noise of electrical machines on the environment Reg number 97-7933A: abstract. Candidate of Physical and Mathematical Sciences./ Medvedev Viktor Tikhonovich, - Moscow, 1997-46 p.
22. Kuklin, D. A., Experimental-Analytical Methodology for Separating the Contribution of Noise Sources for the Development of Noise Protection, on the Example of Construction and Road Machines: Diss. Candidate of Technical Sciences./ Kuklin, Denis Alexandrovich, - SPb, 2002 - 26 p.
23. Nazarenko, V. I., The Hygienic Significance of Increased Individual Sensitivity to Industrial Noise and General Low-Frequency Vibration. / V. I. Nazarenko - Kyiv, 1991. -18p.



ISSN 3030-3907

24. Suvorov G.A., Ovakimov V.G., Morphofunctional changes in the pancreas under the influence of a low-frequency acoustic spectrum "News of Clinical Cytology of Russia." - Pp. 116-118.
25. Svidoviy, V. I. The combined effect of noise and infrasound on the body, problems of hygienic regulation and prevention: abstract of the dissertation of Doctor of Medical Sciences: 14.00.07/ Svidoviy Vasily Ivanovich, - SPb, 1994 - 50p.
26. Khlopina, N. G., Exposure to Tissues of Certain Internal Organs // Histogenetic Analysis of Tissue Variability and Regeneration: Materials of Scientific Council.., Dedicated to the 100th Anniversary of Birth/ N.G. Khlopina, V.G. Ovakimov-SPb., 1997. - 67p.
27. Chedd, G., Sound. Translated from English by G.I. Kuznetsov. Edited and with a foreword by S.B. Gurevich / G. Chedd. 1975. - 206 p.
28. Gazaryan, G. S. Protection of personnel of offshore oil and gas production facilities from noise and vibration: Reference Guide / G. S. Gazaryan, L. I. Vechxayzer. Moscow: Nedra, 1987. - 270 p.
29. Shukyalis, A.V., Protection of Industrial Workers from Vibration and Noise / A.V. Shukyalis - Institute for Advanced Training of Specialists in the National Economy Lit. SSR, Vilnius: Ministry of Higher and Secondary Specialized Education Lit. SSR, 1987-21 p.
30. Zelen, R.P. Features of the functional state of the cardiovascular system in vibratory disease. Physical factors.
31. Shatalov, N.N. The state of the cardiovascular system under the influence of intensive industrial noise: abstract of diss. / Shatalov Nikolai Nikolaevich - L., 1971. - Pp. 28-32.
32. Kayshibaev, S. K., Vegetative-vascular and neuro-humoral disorders in vibration disease in miners: abstract of diss. doctor of medical sciences/ Kayshibaev, Smagul Kayshibaevich, - Alma-Ata, 1974. - 34 p.
33. Kleiner, A.I., Popova T.B., Influence of occupational and production factors on the digestive organs Handbook on occupational diseases Edited by N.F. Izmerov./ A.I. Kleiner, T.B. Popova -M.: Medicine, 1983. - 353-365p.
34. Yeremina, Yu. V. Development and research of special clothing for protecting a person from infrasound: abstract of diss. cand. tech. sciences: 05.19.04. - Saint Petersburg



ISSN 3030-3907