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Sources Of Noise Of Machine Systems (Stanks, Technological Lines, Production Equipment) Used In Machine-Building Shops, Their Norms And Characteristics

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ABSTRACT

The article is devoted to the analysis of noise sources, their norms, and acoustic characteristics arising in machine-building, machine-building, and blacksmithing workshops using the example of JSC "Tashkent Passenger Car Construction and Repair Plant." The study recorded more than 100 types of technological equipment available in large industrial workshops, and their contribution to the acoustic load was studied in detail. In the mechanical engineering workshop, the main sources of noise were hydraulic presses and screw compressors, and the sound pressure was measured in the range of 74-103 dB. In the machine shop, it was found that the sheet folding and plasma units emit noise in the range of 80-106 dB. The highest noise levels were observed in the blacksmith shop, where the sound pressure during the manufacture of wagon springs reached 118-122 dB. Also, the noise generated by chisel hammers and mechanical presses was recorded in the range of 115-130 dB, and in metal-cutting machines - in the range of 105-115 dB. Mechanical, aerodynamic, hydrodynamic, and electromagnetic types of noise are classified according to their origin, and their frequency ranges and spectral characteristics are indicated. Normative standards were analyzed in accordance with the requirements of SanPiN RUz N 0325-16 and GOST 12.1.050-86. The levels of sound pressure at workplaces were assessed in octave frequency bands, and the compliance of working conditions with sanitary and hygienic requirements was determined. The research results show that to reduce noise, technological and structural optimization of the source, the use of acoustic barriers in the path of propagation, and personal protective equipment are necessary. As recommendations, it is proposed to install acoustic screens in the operator's seats, use high-frequency absorbing materials, and develop innovative technical solutions. This approach is relevant in protecting workers' health, preventing occupational diseases, and increasing labor productivity.

Keywords:

Machine-building shop, noise sources, blacksmith shop, SanPiN 0325-16, GOST 12.1.050-86, acoustic barriers, personal protective equipment, occupational safety.

JSC "Tashkent Plant for the Construction and Repair of Passenger Cars" is a large industrial enterprise, commissioned in July 2001. The total area is 103,000 square meters,

of which 54,987 square meters are production workshops: transportation, construction, wheel-wagon, body (body) electrochemistry, heating and water supply, repair, interior

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equipment, paint, battery, municipal, preparatory, supply-production, experimental, woodworking, decorative coatings and repair of wagon parts. In industrial enterprises for various purposes, the main sources of noise are technological and engineering equipment. The

plant's large production workshops are considered to be machine-building, machine tools and blacksmithing workshops, with more than 100 types of machines and equipment in the workshop. Tables 1.1,1.2,1.3.

Table 1.1.
Existing machines and equipment in the blacksmith shop

№	Machine tool name
1	Thermal furnace
2	Belt semi-automatic saw HB 380 L
3	Horizontal lathe processing center CHPU Orion
4	Universal wire emitter ILS-MUK
5	Heating boiler KVG-100
6	Horizontal Milling Machine 6M82
7	Stone cleaning apparatus
8	Air hammer
9	Hydraulic press OKS 1671 M
10	Blacksmith's anvil
11	Vertical Drilling Machine 2H135
12	Screw-cutting lathe 1m63F101
13	Welding semi-automatic machine PDO-517 UZ
14	Cross-Turning Machine 73707 D
15	Lathe screw cutting machine mod.163
16	Cylindrical spring test bench
17	Mechanical saw
18	Vertical Milling Machine
19	2 stone grinding machines

Table 1.2.
Machinery and equipment available in the machine-building shop

№	Machine tool name
1	Milling machine LM-1450 A
2	Welding semi-automatic machine NB 500
3	Screw compressor unit TIDY-20
4	Hydraulic press
5	Welding machine
6	Vertical Milling Machine 6P12-1
7	Turning screw cutting machine 16K20
8	Vertical Drilling Machine 2H135
9	Shaft molding table
10	Heating plate press
11	Combined turning machine
12	Air intake device WINKEL
13	Hitachi Table Drilling Machine
14	Combined woodworking machine
15	6-spindle turning machine
16	Automatic roof cutting machine UNITEK-6
17	Woodworking machine CHPU

18	Prof. Grinding Machine RONDAMAT
19	Universal sharpening machine
20	Screw compressor and cooling device.
21	Wood milling machine
22	1 ton lift

Table 1.3.
Available equipment in the machine shop

Nº	Dastgoh uskunalar nomi
1	Lifting platform 1000 kg
2	Thermal vacuum molding machine
3	RATO screw compressor
4	VD-30 NK Defectoscope
5	UD 4-T Defectoscope
6	Wheel pair flaw detector
7	Magnetic flaw detector device
8	Wagon section flaw detector
9	MD-13PR Control Defect
10	Thickness measurement using ultrasonic sensor
11	UA-4T with an ultrasonic flaw detector rotating device
12	Wagon scales MVA-150 (RDM) with trolley gauge
13	Defectoscope "DIO-562"
14	Hydraulic sheet guillotine AHK D 25100 CNC
15	Hydraulic sheet folding AHK D 25100 CNC
16	Plasma unit JASIC CUT 160
17	Plasma unit UVPR-120 UXP14

In the machine-building shop, the main sources of noise are the following equipment: hydraulic presses and screw compressors. The sound pressure level in the workshop is in the range of 74-103 dB (Fig. 1.1a).

In the machine shop, the main sources of noise are the "Hydraulic Sheet Layer" and "Plasma Unit." In the workshop, the sound pressure level is in the range of 80-106 dB (Fig. 1.1b).

The blacksmith shop is considered the noisiest compared to other production shops. During the manufacture of wagon springs, the sound pressure (Fig. 1.1c) can reach 118-122 dB.



a)



b)



c)

Figure 1.1 Sources of noise:
a) hydraulic press; b) plasma unit; c) hammer.

The noise level generated by the main technological equipment - chisel hammers and mechanical presses for striking workpieces -

reaches 115-130 dB. Sources of noise include cutting machines, guillotine machines, cold stamping machines, cutting equipment, nailing

machines, thread cutting machines, and other semi-automatic and automatic machines. During their operation, the noise level reaches 105 - 115 dB.

The total noise pressure level in machine-building, machine tools, and blacksmith shops, as a result of the operation of metal-cutting equipment, is usually in the range of 85-100 dB.

Sources of noise in the operation of metal-cutting machines are their drive elements (electric motors, gear and belt drives, bearings), especially their wear, unevenness, and imbalance, as well as the direct process of metal cutting and vibrations of the technological system.

Normative noise levels are determined based on SanPiN RUz N 0325-16 "Sanitary Norms for Permissible Noise Levels at Workplaces," which regulates working conditions. This regulatory document establishes the permissible limit values of noise in the production environment and is aimed at reducing their negative impact on the health of workers. The normative limits of noise levels are an important sanitary and hygienic indicator in preventing occupational diseases in workers, maintaining labor productivity, and creating safe working conditions. Noise is classified according to the following characteristics. According to the sources of noise origin, it is divided into:

1. *Mechanical noise*. In serial production, mechanical noise prevails. Its main sources are gear transmissions, impact mechanisms, chain drives, bearings, and other structural elements[1;3-b]. Mechanical noise is caused by the following processes:

- *force action of unbalanced rotating masses,*
- *impacts in the joints of parts,*
- *collisions in cavities,*
- *Material movement in pipes*

The spectrum of mechanical noise occupies a wide frequency range. The determining factors are the shape, size, and type of structure, the number of revolutions, the mechanical properties of the material, the condition of the surfaces, and the degree of lubrication[1;3-b].

Impact-operated machines (for example, chisel press equipment) are sources of pulsed noise, the level of which, as a rule, exceeds the permissible norms at workplaces. In machine-building enterprises, the highest noise levels are observed when metal and woodworking machines are operating.

2. *Aerodynamic noise*. Aerodynamic noise arises in processes associated with gas flows. Their sources are:

- *periodic release of gas into the atmosphere,*
- *operation of screw pumps and compressors,*
- *pneumatic engines, internal combustion engines,*
- *Formation of vortices near solid surfaces.*

The most common equipment: fans, turbochargers, pumps, turbocompressors, and air ducts.

3. *Hydrodynamic noise*. Hydrodynamic noise arises in processes associated with liquids. Their most characteristic manifestation is cavitation noise, i.e., when the pressure drops below a certain limit, the tensile strength of the liquid is lost, and cavities and bubbles filled with vapors and gases are formed. Main sources:

- *hydraulic shocks,*
- *flow turbulence,*
- *cavitation processes*

4. *Noise of electromagnetic origin*. Electromagnetic noise arises in electrical products, in particular, during the operation of electrical machines. The reason is the interaction of ferrimagnetic masses under the influence of changing magnetic fields in time and space.

The noise level generated by electrical machines has a wide range:

- *20÷30 dB - in micro-machines,*
- *100÷110 dB - in large and high-speed machines.*

By spectral character:

- broadband noise (noise with a continuous spectrum width exceeding one octave);
- Tonal noise - noise with discrete tones in its spectrum.

By time characteristics:

- constant noise - noise during an 8-hour workday, the sound level of which changes over time by no more than 5 dB (A).

- unstable noise - this change exceeds 5 dBA

The standardized parameters of constant noise at the reference points are the sound pressure levels L_p , dB in octave frequency bands with average geometric frequencies of 31.5, 63, 125, 250, 500, 1000, 2000, 4000, and 8000 Hz.

The octave line is a frequency range where the upper limit frequency is 2 times higher than the lower.

$$f_B = 2 \cdot f_H \tag{1.1}$$

Average geometric frequency per octave band of frequencies:

$$f_{CT} = \sqrt{f_H \cdot f_B} \tag{1.2}$$

In workplaces in production and auxiliary buildings, in premises of public buildings, the permissible levels of sound pressure, dB, should be taken according to Table 1.4[2].

Table 1.4

Permissible levels of sound pressure, sound levels, and equivalent sound levels in production buildings and workplaces on the territory of enterprises

N t/r	Type of labor activity, workplace	Sound pressure levels in octave ranges of geometric mean frequencies, dB, Hz										Levels sound and equivalent degrees sounds in dB (A)
		31,5	63	125	250	500	1000	2000	4000	8000		
1	2	3	4	5	6	7	8	9	10	11	12	
1.	Creative activity, high-demand managerial work, scientific activity, design and engineering work, teaching, medical activity; the following workplaces: directorate rooms, design and engineering bureaus (computers, computer programmers), laboratories for theoretical developments and data processing, patient reception rooms at healthcare centers.	86	71	61	54	49	45	42	40	38	50	
2.	Work requiring high qualifications, requiring concentration, administrative and managerial activities, measurement and analytical work in laboratories; the following workplaces: workshops, office premises, offices, and laboratories.	93	79	70	63	58	55	52	50	49	60	
3.	Operations performed with frequent instructions and acoustic signals, activities requiring constant auditory control, operator work carried out according to a specific schedule and instructions,	96	83	74	68	63	60	58	56	54	65	

	dispatch activities; the following workplaces: dispatch service rooms, foremen's offices and rooms, data processing halls on electronic computers.										
4.	Work requiring concentration, activity with high demand for remote control of observation processes and production cycles; the following workplaces: control panels in observation and remote control offices without the use of verbal telephone communication, laboratory rooms with noise equipment, rooms with noise units of computers.	103	91	83	77	73	70	68	66	64	75
5.	Performance of all types of work, except those specified in clauses 1-4 and similar types of work, at permanent workplaces in production premises and on the territory of enterprises.	107	95	87	82	78	75	73	71	69	80

In order to further improve working conditions, ministries and departments of the Republic of Uzbekistan are recommended to reduce the permissible sound levels for certain types of labor activity (professions) when

developing industry-specific regulatory documents for various industries, taking into account the category of workload and intensity (according to Table 1.5).

Table 1.5

Optimal sound levels at workplaces for labor activity of various weight and stress categories, dB (A).

Category of work intensity	Category of labor intensity			
	light - I	Moderate - II	Heavy - III	Very Heavy - IV
Low-Stress - I	80	80	75	75
Moderate stress - II	70	70	60	60
Tense - III	60	60	-	-
Very Tense - IV	50	50	-	-

Conclusion

The research results show that the noise levels arising during the production process in machine-building, machine-building, and blacksmithing workshops are significantly higher than current sanitary and hygienic standards. In particular, noise pressure levels of

74-103 dB were recorded in the machine-building workshop, 80-106 dB in the machine-building workshop, and 118-122 dB in the blacksmithing workshop. It has been established that the noise of blacksmith hammers and mechanical presses reaches 115-130 dB, and metal-cutting machines operate in

the range of 105-115 dB. These indicators increase the risk of occupational diseases in workers, in particular, hearing loss, diseases of the nervous system, and cardiovascular diseases. Sources of noise were divided into mechanical, aerodynamic, hydrodynamic, and electromagnetic types, and their spectral characteristics and frequency ranges were analyzed. Based on regulatory documents (SanPiN RUz N 0325-16 and GOST 12.1.050-86), the permissible levels of sound pressure at workplaces were determined and the actual results were compared with them. Based on the results, technological and structural optimization, the use of absorbing acoustic screens and panels in the path of noise propagation, as well as the widespread introduction of personal protective equipment are recommended as effective methods of noise reduction. In general, to ensure safe working conditions at production enterprises, it is necessary to implement a set of anti-noise measures. Innovative technological solutions, the use of heat-resistant acoustic materials, and personal protective equipment that meet ergonomic requirements serve to protect the health of workers and increase labor productivity.

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