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Noise as a Criterion for Designating Sanitary Protection Zones of Traffic Arteries

Vasily E. BURAK

Vasily E. Burak
The 1520 Group of Companies LLC, Moscow, Russia.
✉ *v.burak@1520.ru.*

ABSTRACT

The article is devoted to the study of a possibility of designating the boundaries of sanitary zones (distancing) for traffic arteries outside settlements within the right-of-way.

The study was conducted regarding the current Russian laws, projects of possible changes in legislation and draft amendments. It offers definitions of the right-of-way and of sanitary zone and highlights topics that have not yet been regulated.

At the same time, the research methods are of universal character and after introducing other regulatory parameters may be applied for similar research in other countries as well.

Calculations and field studies allowed to find that within the railway right-of-way and with the existing train traffic intensity, equivalent continuous sound pressure level in aggregate does not exceed the established maximum permissible level of 80dBA for personnel performing their labour functions within the railway right-of-way.

A growth in the Leq/LAeq on the right-of-way from 80,0 to 95,0 dBA may lead to an increase in the hazard class (subclass).

An analysis of the actual results of a special assessment of working conditions at JSC Russian Railways showed in the vast majority of cases the acceptability of working conditions evaluated according to noise factor measured at the workplaces of employees working during full or part-time shift on the right-of-way. Hazardous working conditions at the level of some subclasses for certain professions (operator of track measurement, railway track worker) arise rather due to indicators of severity of the labour process.

Keywords: railway, sanitary protection zone, sanitary distancing, right-of-way, noise, special assessment of working conditions.

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INTRODUCTION

Sanitary protection zones (SPZ) are established around various production facilities that are a source of negative impact on the environment, employees, and the population. SPZ are designed to localise and reduce the negative impact to the values determined by hygienic standards.

Sanitary protection zones in the Russian Federation are established, changed and ceased to function by adopting relevant legislation regarding capital development facilities if:

• these facilities are sources of chemical, physical and biological impact (*CPBF, where F mean factors*);

• the impact affects directly the human habitats;

• the impact exceeds the values established by sanitary and epidemiological requirements outside the boundaries of capital development facilities[1].

The human habitats are understood to be urban and rural settlements[2].

Sanitary and epidemiological requirements are adopted by the state bodies separately for the population and for organisations of various forms of ownership.

The Rules[1] adopted by the Government of the Russian Federation do not contain instructions governing the establishment of sanitary zones for transport routes.

Sanitary and epidemiological rules and norms (further referred to as SanPiN) 2.2.1/2.2.2.1200–03 require the establishment for hazardous transport infrastructure facilities (road, rail, air, pipeline facilities, etc.) of sanitary distancing up to the boundaries where the effect of CPBF will be reduced to the level or will be below the hygienic standards[3].

Standard requirements for sanitary distancing have not been developed, although such a need exists and is justified [1].

Industrial site according to[3] is a land plot on which an industrial facility is located which legally owns this land plot. The right-of-way, by its very nature and purpose, is an industrial site for transport road facilities[4].

From all the described above, it can be concluded that, according to the current Rules, SPZ (sanitary distancing) for traffic arteries are designated in case of exceeding the sanitary and epidemiological requirements (not specified which ones) and include a right-of-way. According to the project [2] SPZ are established in case of chemical, physical and (or) biological impact that exceeds the sanitary and epidemiological requirements and must be located outside the boundaries of land plots legalised according to established procedures and intended for economic activity by capital development and other facilities in accordance with the classification, established by sanitary and epidemiological requirements.

Most of traffic arteries in the Russian Federation pass outside the settlements, hence impossibility of the impact of CPBF in this case on the population. For the same reason, it is impossible to use hygienic standards stipulated for residential areas both inside the right-of-way and outside it [3].

Based on the foregoing, according to the current legislation, SPZ (sanitary distancing) outside the settlements can be established only within the right-of-way, and according to the legislative project, it should not exist at all.

In case of establishing the boundaries of SPZ (distancing) along the boundary of the right-of-way, it is important to determine the choice of sanitary and epidemiological requirements. Currently, various standards are applied for industrial sites and for residential areas. Since the right-of-way is not intended for habitation, the choice of these requirements for settlements will be incorrect. The only and correct choice of sanitary and epidemiological requirements for the production environment, since the right-of-way is one of the working areas of personnel serving transportation and maintaining transport facilities located on it [3].

The solution to the issue of establishing SPZ outside settlements can be found, as an example, based on an assessment of the impact of noise emanated from roads as part of a special assessment of working conditions of personnel who are permanently or temporarily working on the right-of-way land plot.

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[1] Decree of the Government of the Russian Federation dated 03.03.2018 No. 222 «On adoption of the Rules of designating sanitary protection zones and of the use of land plots situated within the boundaries of sanitary protection zones». [Electronic resource]: https://base.garant.ru/71892700/. Last accessed 03.06.2021.

[2] Federal law No. 52-FZ «On sanitary and epidemiological wellness of the population» dated 30.03.1999. [Electronic resource]: http://www.consultant.ru/document/cons_doc_LAW_22481/. Last accessed 03.06.2021.

[3] SanPiN 2.2.1/2.1.1.1200-03. Sanitary protection zones and sanitary classification of enterprises, facilities and other objects. [Electronic resource]: https://docs.cntd.ru/document/902065388. Last accessed 03.06.2021.

[4] Since the topic does not refer to the issues of ownership of the right-of-way or nonpossessory rights (e.g., easement), it does not consider here and further in the article either legal aspects or relevant regulatory features of Russian and international legislation. – *Ed. note*.

For railways, noise within the right-of-way outside settlements is generated mainly by train traffic. There are three main groups of noise production:

• rolling noise (prevails in the speed range of 60–300 km/h);

• equipment noise (50–60 km/h);

• aerodynamic noise (over 300 km/h) [4].

Specific noise figures depend on the types of trains. Thus, passenger trains at a speed of 30–120 km/h generate noise in the range of 78–88 dBA, electric trains at a speed of 40–120 km/h create the noise of 76–90 dBA, and higher-speed trains of Sapsan series at a speed of 100–220 km/h generate noise of 68–86 dBA [4–7].

The noise intensity depends on the speed of the train. The higher is the speed, the higher is the noise intensity [4–6].

The maximum permissible noise level for workplaces, regardless of job positions and duties, is standardised at Leq/LAeq of 80 dBA[5]. It serves as one of the criteria for establishing a hazardous class (subclass) in the process of conducting a special assessment of working conditions[6].

The relevance of the study is determined by the need to develop criteria for establishing SPZ (sanitary distancing).

The *objective* is to reduce the cost of designating a SPZ. The task is to study the possibility of using the results of a special assessment of working conditions as per noise factor as a criterion for designating the boundaries of SPZ.

RESEARCH METHODS

The measurements were carried out with the «Assistant» Total + noise and vibration analyser, serial number 231716, verification certificate No. SP 2791442, the date of expiration of the verification period was November 21, 2020.

Direct single measurements were carried out in May 2020 in accordance with the instruction manual for the device. The measurement time fully covered the interval of train movement. The results of three measurements at the single point did not differ by more than ±3 dB. The main axis of the measuring device was directed perpendicular to the track. There were no foreign objects between the microphone and the noise source. The height of the microphone position was 1,5–1,8 m.

The device was calibrated at the beginning and at the end of the measurements with an acoustic calibrator «Zashchita-K», serial number 124416, verification certificate No. SP 2662786, the date of expiration of the verification period was May 26, 2020.

The object of research is the railway right-of-way on Moscow–Khimki section of Oktyabrskaya railway[7].

RESEARCH RESULTS

Traffic noise affecting an employee within the right-of-way has its own characteristics. First, it is intermittent (non-constant) noise, which implies the use of specific techniques when measuring noise.

Outside settlements, the train speed is higher and generates noise up to 95 dBA. Within the right-of-way and up to 50 m, it decreases slightly, by about 0,5–1,5 dBA.

The negative impact of train noise on an employee depends not only on the noise emitted by an individual train, but also on the duration of exposure to this factor during the shift. To clarify the dependence of the actual level of exposure to noise on the employee and to establish the dependence of the hazard degree on the level of sound generated by a vehicle, the appropriate calculations were made for the most significant range of 80–95 dBA with a step of 5 dBA (Table 1).

The data obtained clearly show that the degree of negative impact of noise depends on the time of an employee's exposure to it («protection by time»). Working conditions refer to hazard class 2 with any time of exposure to an LAeq up to 80,0 dBA inclusive and up to a full work shift. A sound level of 85 dBA does not have a negative effect for at least 2 hours, at 90 dBA – for at least 0,5 hours.

At all other time intervals, hazard class 3 is recorded (subclasses 3.1 and 3.2).

The presented hazardous working conditions are located on the graph above the MPL (maximum permissible level) line (Pic. 1).

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[5] Order of the Ministry of Labour of the Russian Federation dated 24.01.2014 No. 33n (version of 27.04.2020) «On approval of the Methodology of conducting special assessment of working conditions, of the Classifier of hazardous and (or) dangerous industrial factors, of the form of the report on the special assessment of working conditions and of guide to fill it». [Electronic resource]: http://www.consultant.ru/document/cons_doc_LAW_158398/. Last accessed 03.06.2021.

[6] Federal Law dated 28.12.2013 No. 426-FZ «On special assessment of working conditions». [Electronic resource]: http://www.consultant.ru/document/cons_doc_LAW_156555/. Last accessed 03.06.2021.

[7] Oktyabrskaya or October railway, a subsidiary to Russian Railways JSC. – *Translator's note*.

Table 1

Equivalent continuous sound pressure level and hazard level for personnel depending on the exposure time (compiled by the author)

Indicators	Exposure time, hour								
	0,5	1	2	3	4	5	6	7	8
Noise, dBA	68,0	71,0	74,0	75,7	77,0	78,0	78,8	79,4	80,0
Class (subclass)	2	2	2	2	2	2	2	2	2
Noise, dBA	-	76,0	79,0	80,7	82,0	83,0	83,8	84,4	85,0
Class (subclass)	-	2	2	3.1	3.1	3.1	3.1	3.1	3.1
Noise, dBA	78,0	81,0	84,4	85,7	87,0	88,0	88,8	89,4	90,0
Class (subclass)	2	3.1	3.1	3.2	3.2	3.2	3.2	3.2	3.2
Noise, dBA	83,0	86,0	89,0	90,7	92,0	93,0	93,8	94,4	95,0
Class (subclass)	3.1	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2

Table 2

Ranges of noise measurement at workplaces of personnel employed at the facilities within the right-of-way [8; 9]

The name of the workplace (profession, position)	Noise, dBA	Class (subclass) of working conditions as per noise	
		when protected by time	based on actual measurements
Outdoor cleaning operative	58–73	2	2
Foreman (main occupation) of current track maintenance and repair works	65–81	2	2
Trackwalker	65–81	2	2
Operator of track measurement	65–81	2	2–3.1
Roadmaster	65–81	2	2
Railway track worker	70–80	2	2–3.2
Bridge and structure maintenance worker	74–94	2	2–3.2
Tractor driver (Belarus-922)	60–75	2	2

The same trend persists for contractors performing maintenance works on land plots of the right-of-way and in protection zones, fighting against unwanted vegetation and collecting garbage.

To find out the reasons for reduction of the noise hazard class, the time of the exposure to the noise of passing trains was calculated using the example of Moscow–Khimki section during the day of May 19, 2020.

The number of passenger trains passing in both directions per day was 268.

The duration of traffic was 20 hours 57 minutes or 1257 minutes.

The time of continuous passage of all trains relative to one point, constituted in total 4,27 %.

With an eight-hour working day, this will be 20,5 minutes, and considering the increase in train traffic during peak hours (+ 30 %) this will be up to 26,7 minutes.

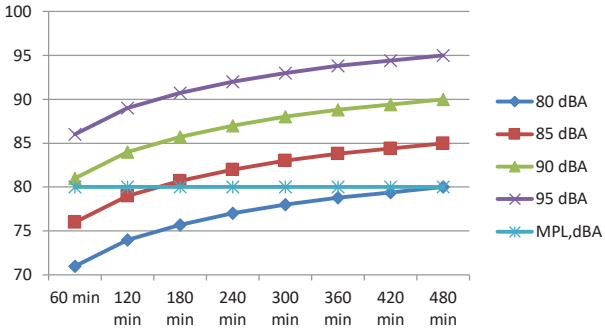
Comparing the obtained data with the Table 1 and the picture, we can conclude that for a given train traffic intensity, the noise up to 90 dBA inclusive generated during by train movement does not go beyond the boundaries of hygienic standards[8] and corresponds to the hazard class 2.

The analysis of actual results of a special assessment of working conditions at JSC Russian Railways showed that in the vast majority of cases, at the workplaces of workers who spend full or part-time shift on the right-of-way, working conditions are established as per noise factor as permissible ones, i.e., belonging to hazard class 2. The final class (subclass) is formed mainly due to the «severity» indicator and corresponds to subclass 3.1. of class 3 and extremely rarely to subclass 3.2 of class 3 (Table 2) [8; 9].

The measured and calculated values of the equivalent sound level in the right-of-way have shown that they are within the ranges established by sanitary and hygienic requirements for personnel working in this area[3].

The application of other standards limiting the noise level on the right-of-way outside the

[8] SanPiN 1.2.3685-21. 21. Hygienic norms and requirements for ensuring safe and (or) hazardless human habitat factors. [Electronic resource]: https://docs.cntd.ru/document/573500115. Last accessed 03.06.2021.



Pic. 1. Working conditions depending on the value of the LAeq and the time of its exposure (nomogram compiled by the author).

settlements is impossible due to the lack of appropriate regulatory legal acts in this field.

Establishing the boundaries of SPZ according to the proposed draft changes to the Rules for establishing SPZ [2] is impossible because the measured and calculated values are lower than MPL standard[8].

CONCLUSION

With an increase in the equivalent sound level from 80,0 to 95,0 dBA, the degree of hazard for employees working on the right-of-way increases proportionally from hazard class 2 to class 3 of subclasses 3.1 and 3.2.

Reducing the time of exposure to noise (time protection) exceeding hygienic standards allows the calculated value to be reduced to a safe level.

Designation of SPZ (sanitary distancing) for railway mainlines outside settlements, according to the current legislation, is possible in terms of the noise indicator within the boundaries of the right-of-way.

The noise indicator cannot serve as a basis for establishing SPZ following the logic of the draft [2], since the measured and calculated values are below MPL standard according to[8].

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Information about the author:
Burak, Vasily E., *Ph.D. (Agriculture), Health and safety engineer at the 1520 Group of Companies LLC, Moscow, Russia, v.burak@1520.ru.*

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