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Use of antivibration gloves when working with a petrol brushcutter Husqvarna 525RX

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Abstract. With the onset of the season in large cities, extensive work begins on green spaces care. The article demonstrates the effect of using antivibration gloves on the level of acoustic impact on the of the Husqvarna 525RX brushcutter operator hands when mowing the lawn. The indicators are measured using the SVAN 948 vibration and sound velocity analyzer.

1. Introduction

Anti-vibration gloves are recommended for use when the vibration level exceeds the accepted one when working with vibrating tools or electrical equipment [1–3, 4]. The activities of workers in engineering, mining, metallurgy, construction and other industries associated with the devices, having a negative impact on human health due to the generated vibration [4]. Prolonged contact with vibrating tools or electrical equipment and poor protection may cause workers to develop hand-arm vibration syndrome. The main protective equipment and occupational diseases prevention today in almost all these industries are anti-vibration gloves and mittens. They are also relevant in one of the most labor-intensive activities in the green spaces care in large cities – lawn mowing.

The use of petrol brushcutters and lawn mowers in recent years has significantly increased the productivity of gardening professionals. Lawn mowers are usually used in large areas with grass cover. In this case, the surface of the lawn should be fairly smooth. Brushcutters have a number of advantages in comparison with lawn mowers. They are lighter, more maneuverable, and more convenient to work on small areas, sloping surfaces, and bumps. However, the operation of these mechanisms is often accompanied by intense acoustic radiation and vibrations. Protection against high sound pressure is provided by ear protectors or earbuds (earplugs). For the safety of operators' hands, anti-vibration gloves must be used.

The purpose of this work is to determine the levels of vibration impact of the brushcutter in the octave spectrum, practical and theoretical assessment of the use of personal protective equipment (hereinafter PPE) when mowing the lawn.

2. Objects and research methods

To conduct an experiment on the applicability of PPE, first of all, the octave spectrum of vibration velocity was determined on the handle of a brushcutter with a petrol engine, Husqvarna 525 (figure 1). Vibration characteristics were measured during lawn mowing (figure 2). The speed of rotation of the brushcutter spindle did not exceed 8500 rpm. The vibration speed sensor was installed on the handle under the right hand. The SVAN 948 noise and vibration analyzer was used to measure surface vibration characteristics. The effectiveness of PPE was determined when using experimental anti-vibration gloves of the NTOT series (the historical name of a series of products designed to protect hands from vibrations) as vibration protection.

Figure 1. Petrole two-stroke brushcutter Husqvarna 525RX: Output: 1000 W. Engine maximum brake power: 1.3 hp. Number of rotations: 6500 rpm.

Figure 2. Process of Husqvarna 525RX octave spectrum vibration speed measuring.

3. Findings

Figure 3 demonstrates the results of measuring the octave spectrum of vibrations on the handle in the absence of PPE (curve 1). Curve 2 shows the change in vibration characteristics affecting the hands of the trimmer operator using the NTOT series of anti-vibration experimental gloves (the historical name of the series of products designed to protect hands from vibrations). The results show that the permissible vibration velocity standards [5] (curve 3, figure 3) are exceeded only in the octave band with an average geometric frequency of 125 Hz by 7 dB. The corrected L_{vcor} vibration level was 5 dB higher than the standard (112 dB – is standard). The use of protective equipment reduced the impact of the brushcutter on the hands in the octave band with exceeding the permissible values of vibration speed to 113 dB. At the same time, the L_{vcor} using gloves was equal to 114 dB. The curves shown in Figure 3 show that the oscillation characteristics of the L_{125} handle in the octave band with an average geometric frequency of 125 Hz are decisive in exceeding the standard indicators.

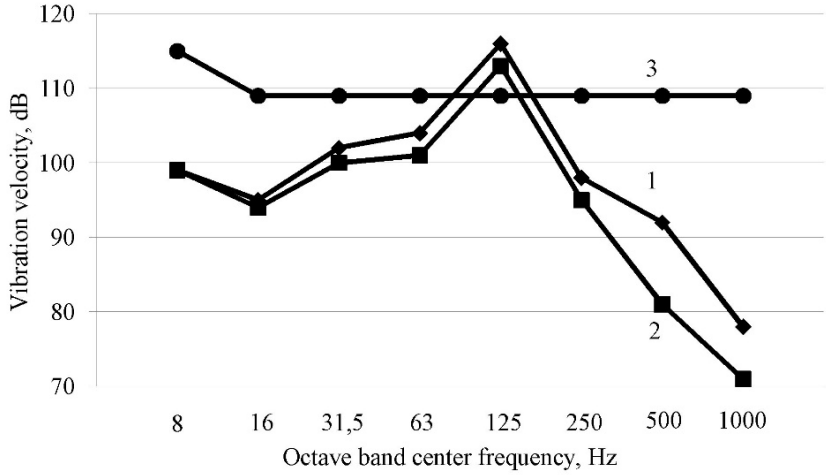

Figure 3. Vibration characteristics of the Husqvarna 525RX brushcutter (1) and vibration levels on the operator's hands with the use of PPE in octave bands (2), vibration rate. Table 1. SanPiN (Sanitary Regulations and Norms) 2.2.2.540-96 (3).

Table 1 and table 2 provide data on the effectiveness of the protective properties of anti-vibration gloves and gloves of various designs. The experimental method is described in the article [6]. This information allows you to make calculations and compare the applicability of PPE when working with a brushcutter. Table 3 demonstrates the values of the vibration velocity in the defining octave band and the corrected vibration level when using gloves of various designs. These data show that the use of 1, 4 and 6 designs bring the L_{125} to the specified level.

Table 1. Effectiveness of protective properties of various designs anti-vibration mittens under the pressure 100 N.

Object	Protective element	Protective properties efficiency, dB in octave frequency bands, Hz						
		8; 16	31.5	63	125	250	500	1000
GOST (State Standard) 12.4.002-97 Type 2a	Up to 8 mm	1.0	2.0	2.0	3.0	4.0	5.0	6.0
Mittens								
Rep. of Belarus Gevorgyan Vibroton (sole proprietorship)	Foam rubber	1.0	2.0	2.0	3.0	5.0	6.0	8.0
	Rubber insert / porous material	1.0	2.0	2.0	4.0	8.0	9.0	9.0

Vostok-Servis-Spetckomplekt (corporation)	Tubular	1.0	2.0	2.0	4.0	5.0	8.0	10.0
Turbo Onega LLC “OPTIMIKST LTD”	Comb.-UV	1.0	2.0	3.0	5.0	8.0	10.0	11.0
Turbo Siberia LLC “OPTIMIKST LTD”	Comb.-UV	1.0	2.0	3.0	4.0	7.0	10.0	12.0
Turbo Classic LLC “OPTIMIKST LTD”	Comb.-UV	1.1	2.3	2.8	4.6	6.2	9.3	10.2
Turbo Donbass LLC “OPTIMIKST LTD”	Comb.-UV	1.0	3.0	4.0	6.0	8.0	11.0	12.0

Table 2. Effectiveness of protective properties of various designs anti-vibration gloves under the pressure 100 N.

Object	Protective element	Protective properties efficiency, dB in octave frequency bands, Hz						
		8; 16	31.5	63	125	250	500	1000
GOST (State Standard)12.4.002-97 Type 2a	Up to 8 mm	1.0	2.0	2.0	3.0	4.0	5.0	6.0
		Gloves						
X-MARINA S-Gloves	Polyethylene foam	1.0	1.8	2.0	4.0	4.5	5.8	13.6
TEGERA EJENDALS	Polyethylene foam	1.0	2.0	2.0	3.0	5.0	8.0	9.0
VibraGuard Ansell	Gelform	1.2	2.0	2.1	4.0	4.5	7.5	9.1
NTOT AMID LLC “OPTIMIKST LTD”	Comb.-UV	1.2	2.1	2.3	4.1	5.1	6.8	7.8
HTOT 3 LLC “OPTIMIKST LTD”	Comb.-UV	1.0	2.0	3.0	5.0	6.0	9.0	10.0
NTOT LORD LLC “OPTIMIKST LTD”	Comb.-UV	1.0	2.0	3.0	6.0	7.0	8.0	11.0
Vibrostat-03 Amparo “Green Shore XXI Century”, Holding Company, LLC	Airgel	1.0	2.0	3.0	5.0	7.0	10.0	12.0

Table 3. Effectiveness of protective properties of various designs anti-vibration gloves under the pressure 100 N.

№	Glove design	L_{125}, dB	L_{vcor}, dB
0	Handle (gloves free)	116	117
1	Vibrostat 03	111	112
2	NTOT AMID	112	113
3	TEGERA	113	114
4	NTOT 3	111	112
5	X-MARINA	112	113
6	NTOT LORD	110	111
7	VibraGuard	112	113
	Normal level	109	112

However, L_{125} cannot be lowered to the limit level. The minimum impact on the hands in this octave band, according to the calculated data, is provided by the 6th design of gloves.

4. Conclusion

The results show a significant protective effect due to the use of anti-vibration gloves when working with the Husqvarna 525RX brushcutter. It can be assumed that a similar effect of reducing the level of acoustic radiation and vibration is possible when using lawnmowers of this class, including those manufactured by other companies.

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