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# ASSESSMENT THE IMPACT OF EXPOSURE TO HAND-TRANSMITTED VIBRATION ON THE HEALTH

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**Abstract**:The work environment affects the organization of work, the workplace, the state of the technical development, architectural design work interior and exterior, physical factors of workplace and hygiene level of work operation. Every work environment represents factors which has influence on workers health. The risk factors of work environment are the physical, chemical and biological factors, physical load, heat and cold load, visual and psychological load and the other factors which has influence on health.The physical factors of environment are the one of the important factors which influence occupational disease formation. The high of risk depends on the intensity, frequency and lenght of applied energy. One of the work areas which in terms of the health influence belongs to the most critical is timber harvesting. A forest creates specific work conditions. Workers are exposed to injurious physical factors like vibrations, noise, solid aerosols, excess expense and one-sedie load. Mentioned factors arising from theuse and operation of machinery and equipment that are part of everyday work in the forest or in the timber-yard. Given that employees are the effects of these negative factors exposed every working day, it is necessary to pay close attention to identifying critical points arising from the use of machinery at work and then provide measures for their elimination. The article deals with the assessment of the effects of vibration on health of employees in forestry. Article describes technological activities in the wood processing and negative factors affecting the health of employees at work. The article describes methods and process of measurement of the vibration acceleration and presents results of experimental measurements of exposure to vibration implemented in actual conditions of practice.
**Keywords**: vibration, measurement, chainsaw, health

## 1. INTRODUCTION

People spend about half of his life at work. There he is exposed to a number of factors so it can be said that the greater part of his health affects precisely those factors that act on him while performing work activities.

In each work area, people are exposed to different environmental factors. There is a several work areas where an increased risk of impact of those factors which have lasting effects on health and which causes the occupational diseases. Progress in machinery and tools innovation facilitates especially hard manual work of workers. However, on the one side that equipments facilitates the work, but on the other hand they may be a source of negative impacts which can damage health of workers.

The work environment affects the organization of work, the workplace, the state of the technical development, architectural design work interior and exterior, physical factors of workplace and hygiene level of work operation. Every work environment represents factors which has influence on workers health. The risk factors of work environment are the physical, chemical and biological factors, physical load, heat and cold load, visual and psychological load and the other factors which has influence on health.

The physical factors of environment are the one of the important factors which influence occupational disease formation. The high of risk depends on the intensity, frequency and lenght of applied energy [1,4].

One of the work areas which in terms of the health influence belongs to the most critical is timber harvesting. A forest creates specific work conditions. Workers are exposed to injurious physical factors like vibrations, noise, solid aerosols, excess expense and one-sedie load. Mentioned factors arising from theuse and operation of machinery and equipment that are part of everyday work in the forest or in the timber-yard. Given that employees are the effects of these negative factors exposed every working day, it is necessary to pay close attention to identifying critical points arising from the use of machinery at work and then provide measures for their elimination.

Authors of this paper focused on assessing the impact of the vibrations transmitted to the hand when working with a chainsaw. For measurements follow the existing work processes accredited workplace in which the author's contribution operate [2, 5].

## 2. MATERIAL AND METHODS –Preparationof vibration measurement

Size measuring vibration acceleration were carried out under normal operating conditions. When measurements are being complied with standards EN ISO 5349-1:2003, ISO 5349-2:2003 and STN 2631-1. Measurement of vibration acceleration was conducted work activity using that hand tools. For gripping hand tool with two hands were the measurements of vibration acceleration for both hands.

The size of vibration emission expressed values of equivalent weighted vibration acceleration $a_{weq\ t}$ in different coordinate axes ($a_{xweq}$, $a_{yweq}$, $a_{zweq}$), as well as the value of the resultant equivalent acceleration value and calculated according to the equation:

$$a_v = \left[\left(k_x . a_{xweq}\right)^2 + \left(k_y . a_{ayweq}\right)^2 + \left(k_z . a_{zweq}\right)^2\right]^{1/2} \quad (4)$$

where: $a_{xweq}$, $a_{yweq}$, $a_{zweq}$ - values of equivalent weighted vibration acceleration in the coordinate axes (x, y, z), $k_x$, $k_y$, $k_z$ -assessment factors in the direction of the coordinate axes of vibration transmitted to the hand ($k_x = 1$, $k_y = 1$, $k_z = 1$), the vibrations transmitted to the whole body ($k_x = 1.4$, $k_y = 1.4$, $k_z = 1$),

Subsequently is equivalent to the weighted vibration acceleration converted to normalized vibration acceleration $a_{weq,\ Tn}$ depending on the duration of the shift according to the equation:

$$a_{weq,Tn} = \left(T / T_n\right)^{1/2} . a_{weq,T'} \quad (4)$$

For the calculation of normalized vibration acceleration measured values were used for each measurement. The normalized vibration acceleration are then compared to the action and limit values of exposure to vibrations. To assess the risk to the health and safety of employees in the work environment is the determining factor, for the vibration transmitted to the hand resulting normalized vibration acceleration in the frequency range 5.6 Hz to 1400 Hz (weighting filter on hand $w_h$). For the final assessment should take into account the value of the hand with the higher measured values [3].

For the assessment was chosen profession, which is the most critical on human health in term of impact of negative factors - sawyer. The basic activity logger is working with a chainsaw. For measurements, working with a chainsaw STIHL brand.

Workload of chainsaw operator during the change consists in carrying out the measurement, marking and cutting strains using chainsaws outdoors. In their activity varies between strains of wood that are placed side by side and prune them for shorter parts.

The length of the sawyer shift was running eight hours with 30 minutes breaks. Employee performs servicing chain saws every day for seven hours.

## 3. RESULTS AND DISCUSSION

Measurement conditions of sawyer activity were the same as the normal job description. The results are shown in Tab. 2. Parameters $a_{xweq}$, $a_{yweq}$, $a_{zweq}$, the measured vibration acceleration in each axis and in the resultant acceleration.

**Table 2.** Measurements results of vibrations acceleration transmitted to the hand

| Measurements results of vibrations acceleration transmitted to the hand | | | | | |
|---|---|---|---|---|---|
| Hand | Measurement duration s | $a_{xweq}$ $m.s^{-2}$ | $a_{yweq}$ $m.s^{-2}$ | $a_{zweq}$ $m.s^{-2}$ | $a_v$ $m.s^{-2}$ |
| Right | 60 | 5,39 | 2,76 | 1,71 | 6,29 |
| Left | 60 | 4,53 | 2,30 | 1,83 | 5,4 |
| Normalized vibration acceleration for the profession chainsaw operator $a_{weq,8h}$, $m.s^{-2}$ | | | | | 2,22 |
| The assessed value of the vibrations acceleration transmitted to the hand $a_{weq,8h}$ extended the uncertainty (22%), $m.s^{-2}$ | | | | | 2,71 |
| Action value standardized vibration acceleration transmitted to the hand $a_{v,8h,a}$, $m.s^{-2}$ | | | | | 2,5 |
| Limit value normalized vibration acceleration transmitted to the hand $a_{v,8h,L}$, $m.s^{-2}$ | | | | | 5 |

Based on the results in Tab. 2 it can be said that has not exceeded the limit value standardized acceleration vibration transmitted to the hand of the employee but the action level is exceeded normalized vibration acceleration. The employer in this case is required to establish and implement a program of technical and organizational measures to reduce exposure to vibration and interacting risks to the lowest possible level.

Fig. 1 shows the progress of the measured acceleration transmission of vibration to the hand of an employee over time. In this particular case, the first 7 seconds when first cut went to saw idling, speed was constant. All three axes have the same course, are not significant variations between them. Figure 2 shows the vibration acceleration at each frequency.

From the frequency analysis of vibration acceleration transmitted to the hand of an employee it can be stated that the increased value of vibration acceleration occur at frequencies in the range of 6.5 to 10 Hz. Other values of vibration acceleration at lower frequencies are negligible compared to them.

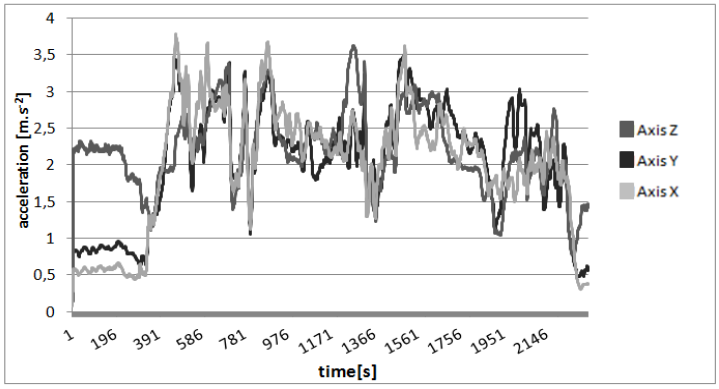


**Figure 1.** Course of vibration acceleration transmitted to the hand of the employee at the time

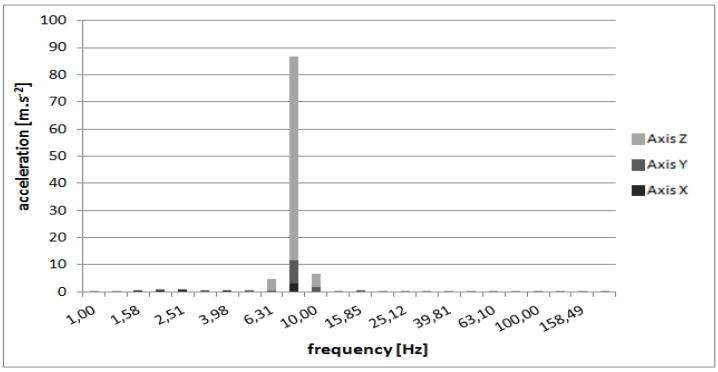


**Figure 2.** Acceleration of vibration transmitted to the hand of the employee, depending on the frequency

## CONCLUSION

In case of the exceeded value of vibration the employer has to prepare and implement a program of technical and organizational measures to reduce exposure to vibration, and affect the risks to the lowest possible level according to Slovak legislation.

It is necessary to focus on the identification of critical points which are the source of these factors and, consequently it is important to take the measures to eliminate them.

When designing technical measures, the decisive role played by engineers who are based on the results of statistical processing of measured values, they can construct or improve protective equipment that workers use at work (for example antivibration gloves).

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