Can we prevent HAVS by using Declared Vibration Emission Value ?

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Abstract

This study reports the results of an investigation into A(8) based on tool vibration values and the effects of hand-transmitted vibration on temporary threshold shifts of vibratory sensation on the finger. The results suggest that the A(8) method based on tool declared values of vibration in accordance with ISO 5349-1 and ISO 28927 series does not readily predict the TTS of a group of individuals after hand-transmitted vibration exposure with different working postures.

Keywords:

Hand-transmitted vibration, Tool Vibration Declaration Value, Manufactuered's Tool Emission Data

Introduction

In July 2002 the European Union published the Directive 2002/44/EC the Physical Agents (Vibration) Directive (PA(V)D) [1]. It outlines new guidelines for exposure to vibration in the workplace. It sets action and limit values for vibration exposure and it describes the employer's obligations to manage the risk from exposure to vibration. This directive is intended as a guide for the employer who has employees using vibrating hand-held power tools and gives practical tips regarding what can be done to reduce vibration exposure from hand-held power tools. The Physical Agents (Vibration) Directive was developed from an original proposal made by the European Commission in 1993. This proposal was revised, amended and eventually agreed by Member States and the European Parliament and came into force on 6 July 2002. The Directive lays down the minimum standards for the health and safety of workers exposed to hand-arm vibration and supports the general requirements for improving health and safety that are outlined in the Framework Directive (2006/42/EC) [2]. For prevention of the industrial disease HAVS, the consideration of A(8) is introduced as a risk assessment method. The A(8) is a combination of the vibration magnitude (calculated as a frequency-weighted r.m.s. of acceleration) and the daily Exposure Times. In the work places, the managers of the vibration tool users must consider the risk of the tool works to the employers before real works according to the consideration of A(8). So, the managers need the vibration magnitude of the individual tool which is appropriate for the use of the tool in the way it will be used by the tool operator. As a consequence of the EU Directive, the manufacturers have to declare the magnitude of the individual tool according to the test protocols (ISO 28927 series)[3]. This purpose of the test protocols was intended that the results be used to compare different models of the same type of machine. However due to the difficulties in carrying out a measurement of vibration magnitude to the accepted standards in the actual work place, employers are estimating workplace risk by calculating A(8) with the estimated work time and tool manufacturer's declared emission value based on the test protocols of ISO 28927 series.

Figure 1. Test Protocol of ISO 28927-5 standard.

As shown in Figure 1, the tool manufacturer's declared emission value is obtained based on highly controlled laboratory conditions. In the worksite, employers are using this value for evaluating the A(8) for the purpose of preventing the development of HAVS within their workforce. In this evaluation, the employers are using the one value from the test protocol result. However, in the real work site, many tool workers are using tools with different kind of tool usages as shown in Figure 2.

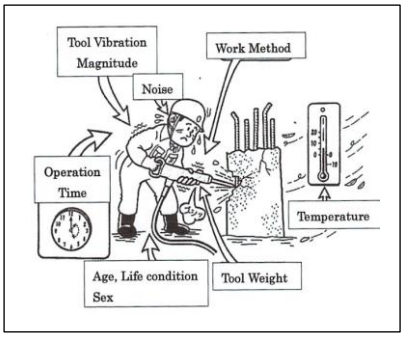


Figure 2. Factors likely to influence the effects of human exposure the hand-transmitted vibration in the working conditions of Annex D of the ISO 5349-1 standard.

It is not clear whether the tool manufacturer's declared emission value based on standards such as ISO 28927 series are appropriate to be used to evaluate the vibration exposure in the real worksite, given the many factors which impact the tools' hand transmitted vibration.

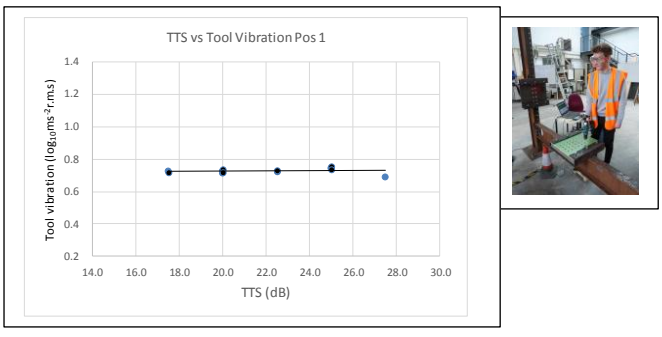
Therefore, in the present study, an experiment was designed to assess whether a Tool's Vibration Declared Values determined using tool vibration measurement standards can assess the risk from the real tool work vibration exposure.

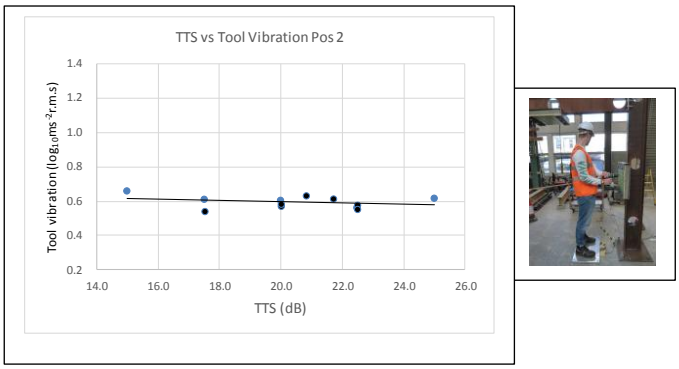
Methods

To study the TTS in fingertip vibratory sensation, the vibratory sensation threshold was measured before and after subjects (male n=12) were exposed to hand-transmitted vibration. The experiment was carried out in a sound-proof room. The room temperature was held at approximately 22℃. Vibration was applied to the right hand through a handle of the electric tool. Three working postures were considered to reflect working practice. These included (1) vertical downwards (single handed) which the same posture of the test protocol of ISO 28927-5 standard, (2) horizontal (tool held in front of subject with both hands) and (3) vertically upwards (overhead, single handed). All subjects performed separate tests with each of the nine possible combinations of tool and posture configuration. The subjects were instructed to clasp the handle tightly and constantly with part of the palm and fingers with a real grip force in the appointed posture. The exposure time was 2 minutes. The threshold of 125 Hz vibratory sensation was measured at the index finger of the right hand. Vibration thresholds were determined with the vibrotactile sensation meter (RION type AU-02A). Vibrotactile thresholds were determined by the method of adjustment. In this method, the measurement was performed three times. Thresholds were calculated by the mean values of three measurements obtained less than 30 seconds after the end of the vibration exposure. The TTS was defined as the difference (in decibels) of the vibrotactile thresholds before and after vibration exposure.

Results

The Figure 3 shows the results the relationship between TTS and the vibration magnitude on the tool handle of each subject when using the same impact drill with different postures. The tool vibration magnitude is in accordance with the tool test protocol such as ISO 28927-5 for a horizontal posture. From this Figure 3, although the TTS value of each subject is changing, the vibration magnitude is constant. Previous research has identified a strong linear correlation between vibration magnitude and TTS. From these evidences, on the Figure 3, when the TTS value is increasing, the hand transmitted vibration might be increasing. However, the tool vibration magnitude shows little change. From these results, although the tool vibration magnitude is the same, the TTS is increasing. This means that the hand transmitted vibration magnitude is increasing. So, the tool vibration declared value is not suited for the risk assessment for the workers





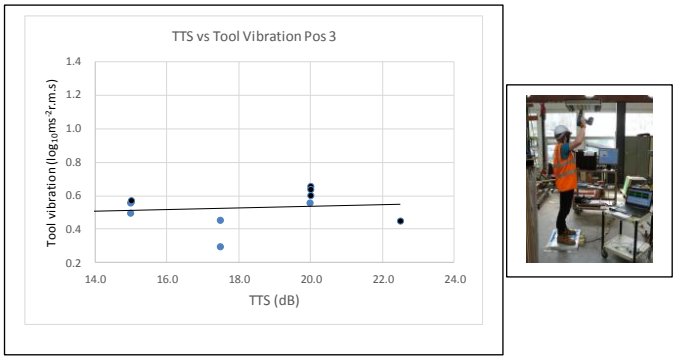


Figure 3. *Results the relationship between TTS and the vibration magnitude on the tool handle of each subject.*

Discussion

From this experiment, although many countries are using the tool vibration declared values based on the ISO 28927 series for the prupose of preventing HAVS, it is clear that the values from the test protocol are not appropriate for all factors in the real work conditions. Also, from the results of Figure 3, the ISO 5349-1 vibration measurement on the tool handle has similar limitations.

Conclusion

Many countries are using the tool vibration declared values based on the ISO 28927 series or following ISO5349 for preventing HAVS. It is clear that the values from these test protocols do not consider all factors in real work conditions. These results indicate that a new evaluation method or equipment is needed to provide a more realistic and practical assessment of HAV exposure. It seems unrealistic to consider HAVS prevention without more realistic assessments. For many years, the factors outlined within Annex D of ISO 5349-1 have not been adequately captured when making an assessment of hand-transmitted vibration exposure for the purposes of prevention of HAVS in real work environments. A desire by employers to adhere strictly to the ISO 5349-1 standard may be contributing to inaccurate dose assessments and inferior outcomes for the worker.

References

[1] EU Directive. 2002/44/EC.

[2] EU Directive. 2006/42/EC.

[3] ISO 29827 Series.

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