

## Whole-Body Vibration

### Introduction

Vibration is classified as one of the physical occupational hygiene hazards in the workplace. It is separated into two sub categories; **Hand-Arm vibration (HAV)** (usually associated with the use of vibrating hand tools), and **Whole-Body Vibration (WBV)** which is experienced when the operator or driver sits on or in a vibrating machine, usually a vehicle such as a forklift, or one of the numerous kinds of vehicles used in agriculture, transport, materials handling, mining and forestry.

Vibration as a hazard has not received the recognition or attention that it deserves when compared to other occupational hazards for a number of reasons. 1) WBV does not have a specific target organ which it affects, making it a hazard with non specific health outcomes which are not easy to clearly discern. 2) It is usually a costly, technical and relatively difficult hazard to measure and evaluate. 3) It is one of the least recognised and most misunderstood of the occupational hazards with fairly limited research carried out in the area compared to other hazards especially in South Africa. 4) It is often difficult and costly to control, and especially in developing countries there are many other more visible occupational hazards that exist and are given a higher priority.

These factors however should not detract from the fact that employees are exposed in the workplace and suffer adverse health effects from vibration exposure both from hand-arm and whole-body vibration and this should be recognised as an important occupational hazard especially for workers using hand tools and professional drivers. The European Union has enacted a physical hazard (vibration) directive to address vibration exposure, and this includes a provision for health surveillance of exposed workers, with some European countries including adverse health effects from vibration exposure in their list of compensatable occupational diseases.

### Health Effects

The health effects vary considerably from situation to situation as other factors such as ergonomic design, damping and attenuation, resonance and many more have a great influence on the exposure characteristics and intensity levels of vibration exposure experienced by employees. The main problem is caused by the vibrational energy waves much the same as noise, that is transferred from the energy source, i.e.: a hand tool or vehicle, into the body of the exposed operator and is transmitted through the body tissues, organs and systems of the individual causing various effects on the structures before it is dampened and dissipates. The body being much the same as a machine can tolerate certain levels of vibrational energy but eventually starts to deteriorate and fail as long-term damage is done and natural processes and systems of the body are disrupted.

Some of the Health effects commonly related to vibration exposure are:

Raynaud□ Phenomenon or Vibration Induced White finger, from vibrating hand tools, affecting the

blood circulation (vascular effects) and nerves (neurological effects), thereby causing a tingling sensation in the affected parts of the hand-arm systems, loss of feeling, numbness, and a characteristic blanching or whitening of the affected parts known as □hite finger?

Whole-body vibration has many more widespread and varied effects and these effects are not particularly clear, as the body does not have one receptor for this energy as for example the ear does for sound energy or noise resulting in hearing loss, but vibration effects are manifested far and wide in the body and may be mistaken for a number of other common ailments.

The most pronounced and common effect is lower back pain which is caused by various mechanisms of vibration on the musculo-skeletal system of the body, namely the degeneration of the intervertebral discs, which leads to an impairment of the mechanics of the vertebral column allowing tissues and nerves to be strained and pinched leading to various back problems. The nutrition of the discs is also affected by long periods of sitting aggravated by vibration exposure, which causes tissue nutrients needed for growth and repair of the discs to flow outwards by diffusion instead of inwards where they are required and this leads to increased wear and reduced repair of the discs. The vertebral bodies are also damaged by the vibration energy that leads to an accumulation of micro fractures at the end plates of the vertebral bodies and associated pain. Muscle fatigue also occurs as the muscles try to react to the vibrational energy to maintain balance and protect and support the spinal column, but these are often too slow as the muscular and nervous system cannot react fast enough to the shocks and loads being applied to the body. Other health effects that have been associated with whole-body vibration and especially the driving environment are haemorrhoids, high blood pressure, kidney disorders and even impotence and other adverse reproductive effects in both men and women.

## Evaluation

Evaluation of vibration can be a complex and costly exercise in order to quantify the exposures and frequencies. However for hand-arm vibration it can be a cheaper exercise when a special attachment is used for a type 1 sound level meter that is held in the hand of the operator of a vibrating hand tool and measures the required parameters.

Whole-body vibration on the other hand is more complex as many aspects have to be taken into account and the measuring arena is mobile and may be required to move over great distances. This is when accelerometers are used on the seat of the vehicle on which the driver sits and radio telemetry systems allow data capture over distances.

However it is not always necessary to spend great sums of money on evaluation of vibration exposures, when a good risk assessment exercise is carried out taking into account factors such as exposure periods, worker complaints and symptoms, medical records and ergonomic principles and design at the workplace or on the vehicle. If a driver or worker has a genuine complaint e.g.: a

3 [http://www.asosh.org/TopicSpecific/wholebody\\_vibration.htm](http://www.asosh.org/TopicSpecific/wholebody_vibration.htm)

forklift driver with lower back pain then something should be done to try and rectify this. The money would be better spent on control measures such as improved seating or driving surfaces etc or the purchase of a better quality hand tool that reduces vibration at the source. In developing countries we often forget that we do not necessarily need to carry out first world, highly technological evaluation in order to control a problem, and this attitude often leads to the hazard remaining uncontrolled because it is too costly to evaluate.

## Control

Vibration is a complex hazard that does not have one control measure that will solve all problems and requires a holistic approach using sound occupational health and safety principles of control taking into account the control measures included under the areas of engineering and administrative control. Personal protective equipment can be used such as anti-vibration gloves to reduce the transmission of vibration to the hand-arm system, but care should be taken when using an unproven device such as a kidney or back belt for whole-body vibration, as this remains a controversial means of protecting the back and spinal system against this type of hazard and this practice is not used or recommended in any other country in the world except parts of South Africa and is a hot and controversial topic even when used for manual lifting activities. See [Back/Kidney Belts](#).

## Useful Websites on Vibration

For more information on vibration the following web sites can be accessed for more in-depth and up to date information:

**Case study: Ergonomics issues involving forklifts** (by Burgess-Limerick R). This site offers various case studies, including problems caused by forklifts as well as other ergonomic issues. [http://www.uq.edu.au/~hmrburge/Case\\_Studies/Forklift/forklift.html](http://www.uq.edu.au/~hmrburge/Case_Studies/Forklift/forklift.html)

**Canadian Centre for Occupational Health and Safety (CCOHS)**. Physical Agents: Vibration. Information regarding health effects of hand-arm and whole-body vibration as well as the measurement, control and applicable standards applicable to vibration control and assessment. [http://www.ccohs.ca/oshanswers/phys\\_agents/vibration/vibration\\_intro.html](http://www.ccohs.ca/oshanswers/phys_agents/vibration/vibration_intro.html)

**Health and Safety Executive (HSE)** - Free information leaflets in PDF format for download on both hand-arm and whole-body vibration. <http://www.hse.gov.uk/pubns/vibindex.htm>. and information document on [Reducing risk of hand- arm vibration injury from hand held power tools](#). [393 kb]

**National Institute of Occupational Safety and Health (NIOSH)** - Human factors research. Mining human factors design. Seating design guidelines: Human Factors Design Recommendations for Underground Mobile Mining Equipment. [http://www.cdc.gov/niosh/pot\\_set1.html](http://www.cdc.gov/niosh/pot_set1.html).

4 [http://www.asosh.org/TopicSpecific/wholebody\\_vibration.htm](http://www.asosh.org/TopicSpecific/wholebody_vibration.htm)

**Workers Compensation Board British Columbia** report. Whole-body Vibration and Back Disorders among motor vehicle drivers and heavy equipment operators ? A review of the scientific evidence.

[http://www.soeh.ubc.ca/research/WBV\\_Report.pdf](http://www.soeh.ubc.ca/research/WBV_Report.pdf) [210kb]

**Occupational Health clinics for Ontario Workers inc.** - Ergonomics and Driving. [613kb]

[http://www.oshforeveryone.org/wsib/files/ont\\_ohcow/driving.pdf](http://www.oshforeveryone.org/wsib/files/ont_ohcow/driving.pdf).

**Vibration Injury Network.**

[http://www.humanvibration.com/EU/VINET/html/final\\_report.htm](http://www.humanvibration.com/EU/VINET/html/final_report.htm). The main objective of the Vibration Injury Network was to advance methods for the detection and prevention of injury due to vibration exposures at work. This is being achieved through: **1)** Development of common methods for health surveillance, including the development of improved methods for the detection and diagnosis of disorders. **2)** Establishment of dose-response relationships between vibration exposures and injury, through collaborative epidemiological research. **3)** Investigation of the interaction between vibration and other environmental, ergonomic and individual factors, through collaborative laboratory experiments. **4)** Improvement of methods for preventing disorders, including consideration of current standard methods for hazard surveillance and for testing the protection provided by gloves and seats. Various reports and documents in pdf format are available at this site.