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A PATH FOR HORIZING YOUR INNOVATIVE WORK

VIBRATION AND ITS EFFECT ON HUMEN BODY

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Abstract

Exposure to vibration body may cause health problems, e.g. lumbago. The risk will depend on intensity and duration. Exposure to vibration in vehicles varies due to several factors as the vehicle type, the terrain condition, the driver, the speed etc. To estimate the health risk, the measurement strategy has to consider this variation. Furthermore, to understand the importance of different preventive strategies, the cause of the variation has to be known. The objective of this study was to describe variation in exposure to body during occupational operation of forwarder vehicles and to investigate sources for variation.

INTRODUCTION

Vibration is the periodic motion of particles away from their position of equilibrium .It is characterized by its frequency, acceleration and direction . The resonance band for the body is 4---8 Hz .long –term exposure to one gravity unit (1 g) of vibration at this frequency can affect peoples health. The following forms of vibration are of most concern to industries— --Whole body vibration associated with transportation.

-- Whole body vibration associated with the operation of large production machinery ---Segmental vibration associated with the operation of power tools.

There are three parameters while testing the effect of vibration on human body tolerances

1. Varying frequency
2. Acceleration
3. Duration

Acceleration is also expressed in terms of gravity unit g .Where 1g =10 m/sec^2 (approx)

The vibrations are categorized in to 3 levels.

Low frequency 0---6 c/s , Tolerable limit AF^3 = 2,Medium 6---60 c/s AF^2 = 1/3

High frequency above 60 c/s AF = 1/60

(a) Effect on body

A person tolerates vibration slightly better in standing

… Women experience more discomfort than men at the same vibration level

… Acceleration and frequency interact to determine the level discomfort

… Duration of exposure will determine vibration acceptability in the workplace.

Truck, buses, heavy construction equipment produce vibration with frequencies

0.1 –20 Hz, Acceleration 0.2 g –0.4 g , Duration –8 hrs .

(b) Segmental vibration to the hands

(0.59 – 80 g with 8 –500 Hz frequency)

It generate loss of strength, blanching of fingers, pain numbness (insensible) stiffness (hard to move),result with segmental vibration. Some of the known physiological effects of vibration include abdominal pain, loss of equilibrium, nausea, muscle contractions, chest pain, shortness of breath, blurring of image loss of visual acuity. The vibration is at or near the tolerable comfort limit may be experienced for long periods without causing any harm , they reflects on efficiency of operator and produce sensations of fatigue.

Body movement will occur below 6 c/s and above 10 c/s , vibrations are absorbed by body tissue , or insulating pad of seat and suspension. Segmental vibration, primarily to the hands and arms will vary according to the type of tools being used.

(c) Ways to reduce vibration exposure

There are three ways to decrease a person's exposure to vibration –reduce the vibration reduce the length of time a person is expose to it and isolate the person from the vibration with cushions or other isolators. Vibration can be reduced by engineering the equipment or workplaces more effectively. For example

--- Mount equipment on springs or compression pad.

--- Maintain equipment properly, balance and replace worn parts.

---Use materials that generate less vibration.

---- Modify equipment speed,feed, or motion to change the vibration. Characteristics to a more suitable range. The amount of time a person is exposed to vibration can be reduced by alternating the person between work tasks where vibration is present. Isolating a person from the vibration source can be achieved by—

1. By proving cushion or spring.

2. By using spongy rubber.

3. By re-design of tools e.g. by using isolating material.

4. By counter weighting tools

The effect of whole-body vibration is poorly understood. Studies of drivers of heavy vehicles have revealed an increased incidence of the disorders of bowel and the circulatory, musculoskeletal and neurological systems. However, disorders of the nervous, circulatory and digestive systems are not specific to whole-body vibration exposure. These disorders are assumed to be caused by a combination of various working conditions and life style factors rather than by one physical factor alone. During whole Body vibration energy enters the body through a seat or the floor; it affects the entire body or a number of organs in the body. Exposed groups include operators of trucks, buses, tractors and those who work on vibrating floors. Table 1 lists examples of vibration exposure in various industries.

Table 1

Examples of occupational vibration exposure

Industry	Type of Vibration	Common Source of Vibration
Agriculture	Whole body	Tractors
Boiler making	Hand-arm	Pneumatic tools
Construction	Whole body Hand-arm	Heavy equipment vehicles Pneumatic tools, Jackhammers
Diamond cutting	Hand-arm	Vibrating hand tools
Forestry	Whole body Hand-arm	Tractors Chain saws
Foundries	Hand-arm	Vibrating cleavers
Furniture manufacture	Hand-arm	Pneumatic chisels
Iron and steel	Hand-arm	Vibrating hand tools
Lumber	Hand-arm	Chain saws
Machine tools	Hand-arm	Vibrating hand tools
Mining	Whole body Hand-arm	Vehicle operation Rock drills
Rivetting	Hand-arm	Hand tools
Rubber	Hand-arm	Pneumatic stripping tools
Sheet Metal	Hand-arm	Stamping Equipment
Shipyards	Hand-arm	hand tools
Shoe-making	Hand-arm	Pounding machine
Stone dressing	Hand-arm	Pneumatic hand tools
Textile	Hand-arm	Sewing machines, Looms
Transportation	Whole body	Vehicles

Effects of whole-body vibration on Health

Whole-body vibration can cause fatigue, insomnia, headache and "shakiness" shortly after or during exposure. The symptoms are similar to those that many people experience after a long car or boat trip. After daily exposure over a number of years, whole-body vibration can affect the entire body and result in a number of health disorders. Sea, air or land vehicles cause motion sickness when the vibration exposure occurs in the 0.1 to 0.6 Hz frequency range. Studies of bus and truck drivers found that occupational exposure to whole-body vibration could have contributed to a number of circulatory, bowel, respiratory, muscular and back disorders. The combined effects of body posture, postural fatigue, dietary habits and whole-body vibration are the possible causes for these disorders. Studies show that whole-body vibration can increase heart rate, oxygen uptake and respiratory rate, and can produce changes in blood and urine. East European researchers have noted that exposure to whole-body vibration can produce an overall ill feeling which they call "vibration sickness.Many studies have reported decreased performance in workers exposed to whole-body vibration. A complete assessment of exposure to vibration requires the measurement of acceleration in well-defined directions, frequencies and duration of exposure.

How hard a person grips a tool affects the amount of vibrational energy entering the hands; Therefore, hand-grip force is another important factor in the exposure assessment.

Measurement of vibration

A complete assessment of exposure to vibration requires the measurement of acceleration in well-defined directions, frequencies and duration of exposure. How hard a person grips a tool affects the amount of vibrational energy entering the hands; Therefore, hand-grip force is another important factor in the exposure assessment. Most jurisdictions and agencies use acceleration as a measure of vibration exposure for the following reasons:

- Several types of instruments are available for measuring acceleration, the rate of change of velocity in speed or direction per unit time (e.g., per second).
- Measuring acceleration can also give information about velocity and amplitude of vibration.
- The degree of harm is related to the magnitude of acceleration.

A typical vibration measurement system includes a device to sense the vibration (accelerometer), a tape recorder, a frequency analyzer, a frequency-weighting network, and a display such as a meter, printer or recorder.

The accelerometer produces an electrical signal. The size of this signal is proportional to the acceleration applied to it.

The frequency analyzer determines the distribution of acceleration in different frequency bands.

The frequency-weighting network mimics the human sensitivity to vibration of different frequencies. The use of weighting networks gives a single number as a measure of vibration exposure and is expressed as the frequency-weighted vibration exposure in meters per second squared (m/s^2), units of acceleration. Vibration meters equipped with accelerometers can be used for instantaneous vibration measurement.

Some types of sound level meters can measure vibration.

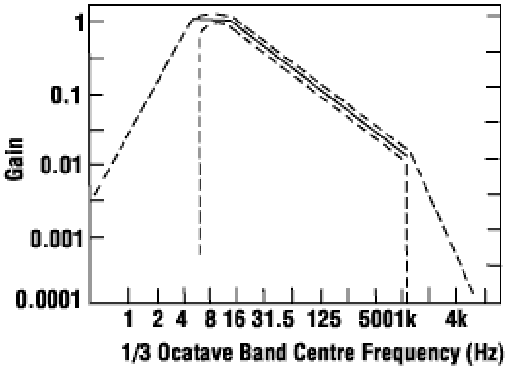

Figure 1

The frequency-weighting network for hand-arm vibration is given in the International Organization for Standardization (ISO) standard ISO 5349. Human hand is not equally sensitive to vibration energy at all frequencies. The sensitivity is the highest around 8-16 Hz (Hertz or cycles per second). Measuring equipment takes this fact into account by using a weighting network. The gain is assigned a value of 1 for vibration frequencies to which the hand-arm system has the highest sensitivity. The dashed lines in Figure 1 represent the filter tolerances in the weighting network.

Controlling elements for vibration:-

1. Anti-Vibration Tools

Using anti-vibration chain saws reduces acceleration levels by a factor of about 10. These types of chain saws must be well maintained. Maintenance must include periodic replacement of shock absorbers. A few pneumatic tool companies manufacture anti-vibration tools such as anti-vibration pneumatic chipping hammers, pavement breakers and vibration-damped pneumatic riveting guns.

2.Anti-Vibration Gloves

Conventional protective gloves (e.g., cotton, leather), commonly used by workers, do not reduce the vibration that is transferred to workers' hands when they are using vibrating tools or equipment. Anti-vibration gloves are made using a layer of viscoelastic material. Actual measurements have shown that such gloves have limited effectiveness in absorbing low-frequency vibration, the major contributor to vibration-related disorders. Therefore, they offer little protection against developing vibration-induced white finger syndrome. However, gloves do provide protection from typical industrial hazards (e.g., cuts, abrasions) and from cold temperatures that, in turn, may reduce the initial sensation of white finger attacks.

3. Safe Work Practices

Along with using anti-vibration tools and gloves, workers can reduce the risk of hand-arm vibration syndrome (HAVS) by following work practices:

- Employ a minimum hand grip consistent with safe operation of the tool or process.
- Wear sufficient clothing, including gloves, to keep warm.
- Avoid continuous exposure by taking rest periods.
- Rest the tool on the work piece whenever practical.
- Refrain from using faulty tools.
- Maintain properly sharpened cutting tools.
- Consult a doctor at the first sign of vibration disease and ask about the possibility of changing to a job with less exposure.

4. Employee Education

Training programs are an effective means of heightening the awareness of HAVS in the workplace. Training should include proper use and maintain vibrating tools to avoid unnecessary exposure to vibration. Vibrating machines and equipment often produce loud noise as well. Therefore, training and education in controlling vibration should also address concerns about noise control.

Precautions for Whole-Body Vibration

The following precautions help to reduce whole-body vibration exposure:

- Limit the time spent by workers on a vibrating surface.
- Mechanically isolate the vibrating source or surface to reduce exposure.
- Ensure that equipment is well maintained to avoid excessive vibration.
- Install vibration damping seats.

The vibration control design is an intricate engineering problem and must be set up by qualified professionals. Many factors specific to the individual work station govern the choice of the vibration isolation material and the machine mounting methods.

The standards and guidelines concerning whole-body vibration are designed to reduce vibration to a level where most workers can perform job tasks without discomfort.

The most widely used document on this topic is Guide for the Evaluation of Human Exposure to Whole Body Vibration (ISO 2631). These exposure guidelines have been adopted as ACGIH TLVs. The ISO standard gives three different types of exposure limits:

- a reduced-comfort boundary
- the fatigue-decreased proficiency boundary
- an exposure limit

The reduced-comfort boundary is for the comfort of people travelling in airplanes, boats, and trains. Exceeding these exposure limits makes it difficult for passengers to eat, read or write when travelling.

The fatigue-decreased proficiency boundary is a limit for time-dependent effects that impair performance. For example, fatigue impairs performance in flying, driving and operating heavy vehicles.

The exposure limit is used to assess the maximum possible exposure allowed for whole-body vibration.

A separate set of "severe discomfort boundaries" is given for 8-hour, 2-hour and 30-minute exposures to whole body vibration in the 0.1 Hz to 0.63 Hz range. As with all standards, it is important to read and understand all the information before applying it in the workplace. These exposure limits are given as acceleration for one third octave band frequencies and three directions of exposure - longitudinal (head <-> toe) and transverse (back <-> chest and side <-> side). The exposure limit is the lowest for frequencies between 4-8 Hz as the human body is most sensitive to whole-body vibrations at these frequencies. It is important to remember that people vary in their susceptibility to effects of exposure to vibration so the "exposure limits" should be considered as guides in controlling exposure: they should not be considered as an upper "safe" limit of exposure or a boundarybetween safe and harmful levels.

Conclusions

1. There is lack of awareness about vibration hazard and its ill effects. This needs to be rectified.
2. The exact number of mine workers occupationally exposed to vibration is not known. Estimated number may be in lakhs.
3. There is an urgent need to investigate the population suffering from vibration exposure above safe limits and its ill effects on their health.
4. The clinical presentation of HAVS in India is not the classical VWF. Subclinical manifestations and dose-response relationships need to be worked out for HAV and WBV in Indian miners.
5. Indian mining legislation is not specific enough to develop a definite strategy for evaluation and control of occupational vibration. Specific rules based on Indian data need to be framed.
6. Vibration monitoring should be made mandatory for all semi-mechanized and mechanized mines.

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