

PROPOSED EU PHYSICAL AGENTS DIRECTIVES ON NOISE AND VIBRATION

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The proposed European Union Physical Agents (Noise) and Physical Agents (Vibration) Directives are likely to be adopted in 2002. Member states will be required to introduce domestic regulation within three years of adoption. The Physical Agents (Noise) Directive is a development of the 1986 Noise Directive which is implemented in the UK as the Noise at Work Regulations. The new Directive proposes to reduce limits on personal noise exposure to a limit value 85 dB(A) and an action value of 80 dB(A), representing a 5 dB reduction when compared to existing legislation. The Physical Agents (Vibration) Directive will, for the first time in the UK, place limits on worker's exposure to whole body and hand-transmitted vibration.

Introduction

European Directives usually lead to Regulations which must be complied with. For example, the UK Manual Handling Operations Regulations (HMSO, 1992) have been derived from European Directive 90/269/EEC (European Commission, 1990). It is the purpose of Regulations to reduce risk factors sufficiently to protect workers' health.

In April 1993 the European Commission proposed a new Directive on physical agents. This directive, once amended by the European parliament in 1994, included annexes with proposed limits on exposure to 'noise, mechanical vibration, optical radiation and magnetic fields and waves' with the intention of future extension to temperature and atmospheric pressure. The details of this Directive were deemed unsatisfactory across many of the associated sub-disciplines. Therefore, it was not developed until 1999 when the German presidency proposed to limit the scope of the directive to human vibration only, with the intention of subsequent introduction of directives in the other areas. Currently, the Physical Agents (Noise) and Physical Agents (Vibration) Directives are in a mature stage of development and are likely to complete their progression through the European Parliament in 2002.

The Physical Agents Directives will approach occupational health from the perspective of the end-user. Therefore, the operator's exposure is assessed, rather than the emission of

the machine itself, although these two quantities are related. There is, however, existing legislation for machinery manufactures. The Machinery Directive (Council of the European Union, 1998) requires noise and vibration emission values to be declared and for reduction of the risk factors. These are required for CE marking. For noise, the Directive states that the instruction manual must contain:

- equivalent continuous A-weighted sound pressure level at workstations, where this exceeds 70 dB(A); where this level does not exceed 70 dB(A), this must be indicated,
- peak C-weighted instantaneous sound pressure value at workstations, where this exceeds 63 Pa (130 dB in relation to 20 μ Pa),
- sound power level emitted by the machinery where the equivalent continuous A-weighted sound pressure level at workstations exceeds 85 dB(A).

For vibration, the instructions must also contain:

- the weighted root mean square acceleration value to which the arms are subjected, if it exceeds 2.5 ms^{-2} as determined by the appropriate test code. Where the acceleration does not exceed 2.5 ms^{-2} , this must be mentioned.
- the weighted root mean square acceleration value to which the body (feet or posterior) is subjected, if it exceeds 0.5 ms^{-2} . Should it not exceed 0.5 ms^{-2} , this must be mentioned.

Declared vibration emission data are collated for some tools and vehicles on the world wide web at '<http://umetech.niwl.se/Vibration/>'.

Noise exposure legislation

Current noise legislation

The UK Noise at Work Regulations (HMSO, 1989) came into force on 1 January 1990 and were the implementation of the 1986 Noise Directive (European Commission, 1986). The basis of the regulations are the 'first action level', 'second action level' and 'peak action level'. The first and second action levels are defined as a personal noise exposure of 85 and 90 dB(A) respectively. The peak action level is defined as a level of peak sound pressure of 200 Pa. The regulations state that:

- every employer shall ensure that a noise assessment is made when any employee is likely to be exposed at or above any action level,
- records must be kept of noise assessments,
- employers shall reduce risk of hearing damage to the lowest level practicable,
- noise exposure must be reduced other than by provision of hearing protection if the second or peak action levels are reached,
- ensure that hearing protection is maintained and used,
- provide information to employees if any action level is exceeded.

In addition to these general requirements, action must be taken at each action level:

- First action level: Employees have the right to demand suitable hearing protectors,
- Second action level: Employees must be provided with suitable hearing protection which reduce risk below exposures at the second action level. Clearly marked ear protection zones must be implemented into which no employees must enter unless wearing hearing protection.

- Peak action level: Employees must be provided with suitable hearing protection which reduce risk below exposures at the peak action level. Clearly marked ear protection zones must be implemented into which no employees must enter unless wearing hearing protection.

Proposed noise legislation

The current draft of the proposed Physical Agents (Noise) Directive (as at December 2001) builds on the 1986 Noise Directive and follows a similar pattern. The main changes from the Noise Directive are that there are three categories of exposure criteria:

- Exposure limit value = 87 dB(A) and peak pressure = 200 Pa
- Upper exposure action value = 85 dB(A) and peak pressure = 200 Pa
- Lower exposure action value = 80 dB(A) and peak pressure = 112 Pa

For the exposure limit value, the Physical Agents (Noise) Directive takes account of the attenuation provided by hearing protection. The action values do not take the attenuation of hearing protection into account. The exposure limit value must not be exceeded. A further requirement of the general duties is that health surveillance must be introduced if a risk to health has been indicated by a noise assessment.

The Directive is being introduced through the co-decision procedure (Borchardt, 2000). Common Position was reached on 29 October 2001 and it is likely to go before the European Parliament for a second reading early in 2002. The Directive could be adopted by the end of 2002, after which Member States have three years to bring into force the laws, regulations and administrative positions required.

Vibration exposure legislation and guidance

Current vibration guidance

There is no legal requirement in the UK to limit exposure to human vibration, apart from general health and safety regulations. However, British and International Standards give guidance on human exposure to vibration and the Health and Safety Executive provide specific limits on exposure to hand-transmitted vibration which is taken as best practise (HSE, 1994).

The Health and Safety Executive (HSE) guidelines for hand-transmitted vibration recommend that preventative measures and health surveillance should be carried out if vibration exceeds a W_h frequency weighted 8-hour equivalent level (A(8)) of 2.8 ms^{-2} . This figure is based on assessment of the 'worst-axis' of vibration at either hand. Even at 2.8 ms^{-2} , 10% of exposed persons would be expected to show symptoms of vibration white finger after eight years (BS6842, 1987b).

For whole-body vibration there are two standards currently applicable: BS6841 (1987a) and ISO2631 (1997). Although these standards can be used in a way that is compatible there are important differences between them (Griffin, 1998, Table 1). It is therefore essential that the methods used are clearly specified in any report, as stating '... measured according to ISO2631...' does not imply a 'standard' method. According to BS6841, a vibration dose value (VDV) of $15 \text{ ms}^{-1.75}$ '...will usually cause severe discomfort...accompanied by increased risk of injury'. ISO2631 defines a 'health guidance caution zone' with a VDV from 8.5 to $17 \text{ ms}^{-1.75}$ and states that 'for exposures below the zone, health effects have not been clearly documented...in the zone, caution with respect to potential health risks is indicated and above the zone health risks are likely'. The HSE

have not produced documents for whole-body vibration aligned with their hand-transmitted vibration guidance.

Table 1. Summary of assessment techniques for whole-body defined in BS6841, ISO2651 and the proposed Physical Agents (Vibration) Directive

	British Standard BS6841 (1987)	International Standard ISO2631 (1997)	Physical Agents (Vibration) Directive
Frequency weighting	Fore-aft: Wd Lateral: Wd Vertical: Wb	Fore-aft: Wd Lateral: Wd Vertical: Wk	Fore-aft: Wd Lateral: Wd Vertical: Wk
Axis multipliers for health	Fore-aft: 1.0 Lateral: 1.0 Vertical: 1.0	Fore-aft: 1.4 Lateral: 1.4 Vertical: 1.0	Fore-aft: 1.4 Lateral: 1.4 Vertical: 1.0
Assessment method	Sum of V DVs	VDV or r.m.s. or MTVV	Ó axes or worst axis
Action values (VDV criteria only)	15 ms ^{-1.75} 'action level'	8.5-17 ms ^{-1.75} 'health guidance caution zone'	Worst axis VDV or Worst axis r.m.s. 8.5 ms ^{-1.75} 'action value' 14.6 ms ^{-1.75} 'limit value'

Proposed vibration legislation

The core of the proposed Physical Agents (Vibration) Directive (as at December 2001) is based around 'limit values' and 'action values' for 8-hour exposures. The action and limit values are set at 2.5 and 5.0 ms⁻² for hand-transmitted vibration and at 0.5 and 0.8 ms⁻² for whole-body vibration. For whole-body vibration, the values are also defined in terms of VDV (Table 1). The directive states that:

- employers shall assess the levels of mechanical vibration to which workers are exposed,
- records must be kept of assessments,
- risks arising from exposure to mechanical vibration shall be reduced at source to a minimum,
- workers shall not be exposed above the exposure limit value
- if the limit value is exceeded, employers must take immediate action and identify reasons for the over-exposure
- information and training must be provided to those exposed to a risk
- health surveillance must be implemented

The proposed Directive includes annexes which described how measurements of vibration should be taken. For hand-transmitted vibration, measurements should be made in accordance with ISO 5349-1 (2001) with the evaluation based on the root sum of the squares of vibration in the three orthogonal axes. For whole-body vibration, measurements must be made in accordance with ISO2631, but restricted to only using r.m.s. or VDV with the worst axis taken as representative.

Common Position was reached on 25 June 2001 and the second reading took place on 23 October 2001. The limit and action values for whole-body vibration were reduced between reaching Common Position and being referred for a second reading. At the time of writing, the Directive is passing through the conciliation procedure and is likely to be adopted at a third reading in 2002, after which member states have three years to implement domestic regulations. Lobbying by industrial representatives is applying pressure to increase the values for whole-body vibration. Derogations from limit values have been

applied to agriculture and forestry as a result of lobbying, so it is possible that important changes could still be made to the text before its third reading.

Discussion

The ultimate goal of Regulation is to avoid damaging workers' health. Unfortunately, inter-subject variation in susceptibility and imperfect agent monitoring mean that the holy grail of a perfect predictor of injury is impossible to achieve. Therefore it might be tempting to err on the side of caution when setting limits. However, if the limits are set too low then some tasks with a low risk might be prohibited and hence industry would bear financial penalties with little improvement in health. Conversely, if the limits are set too high then action that could protect health might not be taken by employers.

A dose-effect relationship has been standardised for noise and for hand-transmitted vibration exposure and so percentages of persons with adversely affected health can be estimated from measures of noise and vibration. For whole-body vibration, no such relationship is established and so setting limits is more difficult. One reason for this is that vibration is just one of a range of factors that might lead to back pain, whereas hearing damage and vibration white finger are specific to the injurious physical agent.

Models of noise exposure predict that after 20 years exposure at the current Second Action Level (90 dB L_{Aeq}), a 40 year old would have a 4% chance of a mean hearing loss of 30dB at 1, 2 and 3 kHz (BS5330, 1976). Reducing exposure to the proposed Limit Value (85 dB L_{Aeq}) would reduce the probability of the 30dB mean hearing loss to 1%. Therefore, a fourfold decrease in reports of noise induced hearing loss would be expected if current compliance with the Noise at Work Regulations is maintained.

The limit and action values for the proposed Physical Agents (Vibration) Directive cannot be directly compared with the HSE hand-transmitted vibration guidance, as the HSE specify 'worst axis' for assessment and the Directive specifies combined axes. However, a multiplier of 1.4 can be used to estimate triaxial exposures from previous single axis measurements (Nelson, 1997). Therefore, the limit value in the proposed Directive is higher than that currently suggested in the UK. Models of blanching for multi-axis stimuli predict that 10% of those exposed at the limit value would experience blanching after 6 years (ISO5349, 2001) compared to 8 years for the HSE guidelines.

For whole-body vibration, it is difficult to predict the extent of improvement in workers' health. Reducing exposure to one of the many risk factors for back pain must be welcomed, although it is possible that the limits are set too low resulting in an unnecessary burden on industry to comply. The Directive will also be helpful in clarifying a standardized procedure for application of ISO2631 at least across Europe.

It seems illogical that the hand-transmitted vibration part of the Directive specifies assessment in three axes whereas the whole-body vibration part of the Directive specifies assessment considering the worst axis only. This represents a step forwards for hand-transmitted vibration but a step backwards for whole-body vibration.

Conclusions

The Physical Agents (Noise) and Physical Agents (Vibration) Directives will limit exposures to noise, hand-transmitted and whole-body vibration. These Directives are likely

to complete their progression through the EU legislative process in 2002 and must be implemented in member states within three years of adoption.

Noise exposure will be reduced when compared to current allowable limits. Limits for hand-transmitted and whole-body vibration will be implemented for the first time.

The reader should take note that the Directives discussed in this paper are currently in a draft form. It is likely that minor amendments will be made to the text of the Directives prior to adoption and it is feasible that limit values will be changed. An unlikely, but possible, outcome is that either, or both, of the Directives fail.

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