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SUCCESSFUL MANAGEMENT OF EXPOSURE TO HAND-ARM VIBRATION

Chris Nelson Technology Division, Health and Safety Executive, Bootle, Merseyside, L20 3QZ.
Paul Brereton Technology Division, Health and Safety Executive, Bootle, Merseyside, L20 3QZ.

1. INTRODUCTION

The effects of hand-transmitted vibration on health (hand-arm vibration syndrome or HAVS) were first reported in the first decade of the 20th century, and have been widely known in the United Kingdom for at least thirty years. In the last years of the 1990s this subject received increasing attention in the news as the courts made substantial compensation awards to workers with vibration injuries.

The law requires employers and others to control hazards to health, and the Health and Safety Executive (HSE) encourages duty holders to take a structured approach to identifying the problem, taking appropriate action and checking the efficacy of those actions. It also advocates the well-known hierarchical approach to risk control: first, elimination of risk by process design, followed by control at source (e.g. by using low vibration equipment) and, finally, by using "people" solutions such as improved methods of working, job rotation, personal protective equipment, information and training, etc. Health surveillance is also required where may be a residual risk of work-related ill-health.

Strategies for control of the risks from hand-arm vibration (HAV) are now well established in some industries, but in many cases the potential exists for more effective and widespread action by employers and other duty holders. The HSE published its guidance on HAV in 1994 [1]. More recently it has featured HAV in its campaign "Good Health is Good Business" and has published further guidance in the form of leaflets for employers and employees [2, 3], a book of risk reduction case studies [4], a video [5] which introduces the issues to employees and others and a managers' guide to vibration risk control on CD-ROM [6]. The guidance seeks to inform of the nature of vibration risks and to show that the problem can be managed successfully. This paper describes various practical approaches to the management of hand-arm vibration, using case studies from different industries, including process replacement, tool selection, and health surveillance.

2. RISK ASSESSMENT

Successful management of an occupational health problem begins with a risk assessment to establish the need for action. This is required by the Management of Health and Safety at Work Regulations 1999 [7]. In many cases, this will be simple:

- the industry has a known HAVS prevalence;
- the process has a known HAVS risk;
- the tools and equipment are known to be associated with HAVS;
- HAVS signs and symptoms exist in the workforce;

while in other cases the employer will need to obtain information to establish whether:

- exposures levels present an unacceptable risk of injury – perhaps exceeding the HSE's action level of 2.8 ms^{-2} A(8).

The need to control vibration exposures and to set up a health surveillance scheme is easily established where the work activity, or the equipment used, has been associated with HAVS elsewhere, or where there is evidence of vibration-related ill-health in the workforce, or where the vibration exposures are thought to be excessive. As a "rule of thumb", use of hammer-action equipment for more than 30 minutes a day, or use of rotary action equipment for more than two hours a day almost certainly indicates risk to the operators; for poorly designed or poorly maintained tools these times could be much shorter. An accurate evaluation of the exposure levels, perhaps using vibration measurement, may not be required, at least in the first instance. Action to control identifiable risks should certainly not be delayed while awaiting exposure information.

Where there is a need to establish a value for the exposure, A(8), a useful estimate can often be made using existing information about vibration magnitudes. For example, manufacturers and suppliers of equipment should be able to advise users about the vibration emission of their products. They should be asked about typical "real use" vibration values for the anticipated use (or misuse) of the equipment, in addition to the emission values measured and declared in accordance with harmonised test standards that do not reproduce likely workplace values.

If measurement of vibration is undertaken in the workplace, there are now several dedicated instruments available for hand-arm vibration measurement. However, HAV measurement is a complex task and it is important that measurements are made by someone with an appropriate level of competence. For example, knowledge and experience are needed for the selection and mounting of vibration transducers and the sampling of work activities to derive a meaningful daily exposure. Measurement and evaluation of exposure should be conducted in accordance with the current International or British Standards [8, 9]. A new version of ISO 5349 has been prepared and was published during 1999 as a Draft International Standard in two parts [10, 11]. Part 2 is a useful source of detailed advice on the practicalities of measurement of vibration in the workplace.

3. CONTROL OF EXPOSURE

3.1 Changing the Process

With any hazard to health or safety, it is preferable to eliminate or reduce the problem by control at source, rather than to rely on palliative measures and people-dependent solutions. If the work process can be designed so that the hazardous activity is not required, then the risk is eliminated, as are the ongoing costs of managing the problem (control, monitoring, health surveillance, etc.). A new process which eliminates vibration exposure, will often bring other financial savings by removing the costs of a manual operation, even if the initial costs are high.

Existing processes can sometimes be modified to reduce vibration. It is worth considering the potential for automation, jig-mounting of tools or components, remote control, improved mounting for vibration isolation, improved ergonomics to reduce operator grip force, etc.

Many vibration exposures result from the need for remedial work. Improved quality control in one industrial process (e.g. the precision of casting of foundry products) can reduce or remove the need

for a secondary process which results in vibration exposure (e.g. fettling of castings), and should therefore be cost-effective.

Case studies illustrating preventive measures for hand-arm vibration exposures have been a feature of HSE publications [4, 5, 6]. The following examples show successful control of vibration at source by the replacement of an existing process or the improvement of an existing one.

- Removal of refractive linings of foundry furnaces: regular manual work with pneumatic hammers was replaced by a hydraulic mechanism which simply pushes out the old lining. This eliminated human exposure to other hazards, including noise, dust and heat, as well as vibration.

- Use of an automatic machining process to cut away corroded material when refurbishing large steel components in railway vehicle repair. The need for grinding by hand was greatly reduced. (This suggestion came from an employee who noticed the machine was standing idle while cutting and grinding by hand went on nearby.)

- The use of a hydraulic crusher in place of hand-operated breakers in the demolition of concrete wall sections during building refurbishment. In addition to the negligible residual vibration exposure, this process also produces less noise and dust.

3.2 Reduced-vibration equipment

Where no alternative to the process causing the vibration has been identified, there is often scope for the reduction of exposures by selecting equipment for reduced vibration emission. Employers' duties under the Provision and Use of Work Equipment Regulations 1998 [12] require that risks to health and safety are taken into account when selecting work equipment: the vibration emission of the equipment should therefore be considered. The suppliers of the vibrating equipment also have legal duties under The Supply of Machinery (Safety) Regulations 1992 [13]. These Regulations, which implement the EU Machinery Directive, require that risks to health and safety are minimised by design, and that information is provided on any residual risks, so that the machinery can be used safely. Declaration of vibration emission values is a specific requirement.

Many manufacturers are now marketing "reduced vibration" tools which produce less vibration than their predecessors. These include grinders, needle scalers, chain saws, hammer drills, breakers, chipping hammers and riveting hammers. The vibration emission values declared by manufacturers is usually measured in accordance with a European harmonised test code. These test methods typically require measurement only in one direction, and define a closely controlled task for the tool to perform during the test. To confirm the apparent benefit from procuring a low vibration tool, the supplier should be asked for information on the vibration emission likely during the intended use of the tool, and how this may vary. For some tool categories, typical "in-use" vibration magnitudes can be substantially different from the declared emission value. The efficiency of the tool also needs to be considered: there may be little or no benefit in selecting a tool for its low vibration emission if it has to be used for a much longer time to complete the work.

The following examples show successful reduction of daily vibration exposures by selection of vibration-reduced tool types.

- A shipyard replaced its angle grinders with a newer design which has an automatic mechanism for the correction of disc imbalance - a major contribution to the vibration. The vibration magnitude for the new tools was about 3.5 ms^{-2} compared with 7 ms^{-2} for the old tools. This reduced the daily exposure from 4 ms^{-2} A(8) to 2 ms^{-2} A(8). By

careful selection of the grade of abrasive disc used with the machines, the efficiency was also improved, with a 40% increase in metal removal rate.

- Scabbling (roughing of concrete surfaces to provide a good bonding surface) and the removal of paint and corrosion from steel structures are often carried out using needle guns. Traditional needle guns can produce vibration magnitudes of about to 15 ms^{-2}. Recent design innovations have resulted in new types with vibration emissions of about 4 ms^{-2}. For work involving use of the needle gun for two hours per day, use of the newer tool type can reduce the daily vibration exposure from about 6 ms^{-2} A(8) to a value less than the HSE's "action level" of 2.8 ms^{-2} A(8).

3.3 Maintenance of equipment

Maintenance will not reduce exposure to vibration, but it can sometimes prevent avoidable increases in vibration transmitted to the hands. Some maintenance tasks are clearly necessary for efficient and safe operation of the tool while others may be neglected because the user does not appreciate the need for action.

- For example, a chainsaw, which had received regular maintenance to the chain (sharpening and adjustment to tensioning) was found to produce vibration magnitudes of nearly 10 ms^{-2}. The rubber mounting bushes on the handle of a chainsaw, which provide the vibration isolation had deteriorated and, when replaced, the vibration was reduced to less than 6 ms^{-2}.

3.4 "People" solutions

If it is not practicable to eliminate or reduce vibration at source, by consideration of the work process or the equipment used, or if risks remain after such measures have been taken, then it becomes necessary to involve the operator directly in the management of vibration exposure. Limiting the daily duration of exposure to the vibration is an obvious approach; this can be achieved by job rotation where the work and the number of available employees permits. When the vibration magnitude for a tool or process is known, it is sometimes convenient to calculate an "allowable exposure time" for which an operator can work before an action level is reached. This allows working schedules to be arranged while controlling exposure. It is important, however, when making such calculations, to allow for any other exposures which may occur during the same working day. Some employers have introduced systems where a number of "points" are allocated to a specified period of work (e.g. 15 minutes) with a particular tool. Workers and/or their supervisors are then able to evaluate and limit daily exposures without resorting to difficult calculations. (A computer calculation facility for multiple exposures is included on the HSE's CD-ROM guidance on management of HAV [6].)

There are many measures which, while not necessarily reducing the exposure in numerical terms, may help to minimise any effects on the health of the individual. These include:

- taking breaks (avoiding long periods of continuous exposure);
- keeping warm – wearing warm clothing and gloves where it is safe to do so;
- exercising the hands and fingers to improve circulation;
- correct selection, use and maintenance of equipment;