Hand Arm Vibration Syndrome

Dust and Noise at work
Hand-arm vibration

What is it?
Hand-arm vibration is vibration transmitted from hand-held power tools, such as hammer drills and concrete breakers to the hands and arms. Where a person’s job involves regular and frequent use of power tools, this can result in a range of health problems, collectively known as hand-arm vibration syndrome (HAVS). Occasional use of power tools is unlikely to cause ill health.

The symptoms of HAVS
The symptoms include one or more of the following:

- Tingling and numbness in the fingers.
- A loss of feeling in the fingers.
- Loss of strength in the hands.
- Painful and disabling disorders of the blood vessels, nerves, joints and muscles of the hands and arms.
- The fingers turning white (only in the tips at first) and becoming red and painful on recovery.

Identifying the signs at an early stage is important as continued exposure to vibration will result in a worsening of the condition, which may become permanent. For some people the symptoms may only take a few months to appear, for others it may take a few years. So regular checks are essential.

How common is it?
HAVS is the most commonly prescribed disease under the Industrial Injuries Scheme in recent years. The HSE state that the advanced stage of HAVS is one of the most common reasons for occupational ill health claims made against employers.

Research commissioned by the HSE suggests over a million people continue to be exposed to high levels of vibration in the workplace. About 40% of those reporting HAVS in the HSE’s Self-reported Work-related Illness Survey also reported work-related deafness or other ear problems, reflecting the fact that work which exposes people to hand-arm vibration is often also noisy.

The effects of HAVS
HAVS is progressive and potentially irreversible. In the early stages, there is evidence that some symptoms will regress once exposure to vibrating tools is stopped. However, the likelihood of reversibility decreases with long term exposure to vibrating tools, resulting in permanent disability.

The effects of prolonged exposure to HAVS include:

- Pain, distress and sleep disturbance.
- Difficulty in carrying out fine work, such as assembling small components or fastening buttons.
- Painful finger blanching attacks when exposed to cold and wet conditions.
- A reduction in grip strength, making it unsafe to carry out some jobs safely.

It is essential, therefore, to avoid further exposure to work involving holding vibrating machinery.
The Physical Agents (Vibration) Directive

The Control of Vibration at Work Regulations 2005 became law in July 2005 and define the minimum health and safety requirements for workers exposed to vibration risks.

The Regulations set two limits. The first of 2.5 m/s$^2$ is for the exposure action value (EAV). This is the daily amount of vibration exposure above which employers are required to take action to control exposure and carry out a health surveillance programme. A higher exposure limit value (ELV) of 5.0 m/s$^2$ is the maximum amount of vibration an employee may be exposed to on any single day.

The Regulations require that employers carry out a risk assessment of each worker’s daily vibration exposure. A health surveillance programme must be set up for workers who are regularly exposed to vibrations above the action level (EAV) and stop any activity where the exposure limit (ELV) is exceeded.

If the risk assessment indicates some workers are exposed to vibration that is over the EAV level, assessments must be provided annually, and arranged by an occupational health provider.

For new employees, a check after six months to identify any workers who may be particularly susceptible should also be considered. If symptoms are discovered, more frequent assessments may be appropriate to assess the rate of progression. In the absence of symptoms, there is no need for further assessment or investigation.

Health Surveillance should be conducted by a qualified medical practitioner or by an occupational health nurse under his/her direction. Health records must be kept in confidence by the occupational health professional, kept up to date and retained for as long as the employee is under health surveillance.

Employees need to be given information about the reasons for carrying out health surveillance and an explanation of their role and responsibilities. Employers are also obliged to train employees on the risks and safe use of vibration tools.

### Vibration levels of some commonly used drills

<table>
<thead>
<tr>
<th>Type of tool</th>
<th>Model</th>
<th>Vibration (m/s$^2$)$^{(1)}$</th>
<th>Vibration (m/s$^2$)$^{(2)}$</th>
<th>Sound power level dB(A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hammer drill 24V</td>
<td>De Walt DW004K2C</td>
<td>8.5</td>
<td>--</td>
<td>102</td>
</tr>
<tr>
<td>Cordless heavy duty</td>
<td>Bosch GSB24VE2</td>
<td>7.5</td>
<td>--</td>
<td>102</td>
</tr>
<tr>
<td>Power drill 18V – Cordless</td>
<td>Hilti SF 180A</td>
<td>9.2</td>
<td>--</td>
<td>100</td>
</tr>
<tr>
<td>Combi hammer</td>
<td>Hilti TE35</td>
<td>8.5</td>
<td>--</td>
<td>100</td>
</tr>
<tr>
<td>Rotary hammer drills – light duty</td>
<td>Bosch GBH 2-26</td>
<td>13</td>
<td>--</td>
<td>102</td>
</tr>
<tr>
<td></td>
<td>Hilti TE6-C</td>
<td>8</td>
<td>--</td>
<td>100</td>
</tr>
<tr>
<td>Rotary hammer drills – medium/heavy duty</td>
<td>DeWalt D25303KL</td>
<td>9.2</td>
<td>--</td>
<td>99</td>
</tr>
<tr>
<td></td>
<td>Bosch 4DFA</td>
<td>--</td>
<td>11</td>
<td>100</td>
</tr>
<tr>
<td>Hammer drill/combi hammer</td>
<td>HSE test data</td>
<td>6-25</td>
<td>--</td>
<td>--</td>
</tr>
</tbody>
</table>

Notes:

1) 3 axis vector sum/vibration (BS EN ISO 5349-1: 2001), or weighted root mean square acceleration value according to EN 50144
2) Dominant axis (BS 6842: 1987) or not specified

Information taken from manufacturer’s manuals.
The HSE vibration exposure calculator

An operators daily vibration exposure (known as the A(8) value) is obtained from the vibration magnitude and the duration of exposure.

To help calculate a safe vibration exposure the HSE has developed an interactive Vibration Exposure Calculator, shown below. Information from manufacturer’s data can be input along with actual or estimated exposure time to calculate the daily vibration exposure.

It can be seen from the table below that an employee regularly using a hammer drill with a vibration of 8 m/s² for more than 47 minutes a day needs to be included in the health surveillance programme. The maximum length of time that an employee can use such a drill is limited to about three hours per day.

The HSE Vibration Exposure Calculator

The HSE Hand-arm vibration exposure calculator can be downloaded free from www.hse.gov.uk/vibration/calculator.htm.

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Limiting exposure – HSE advice
The HSE have published several leaflets and books giving advice to both employers and employees on recognising HAVS and giving advice on how to minimise the risk of the disease. These are listed below.

Advice from the HSE in their leaflet *Health risk from hand-arm vibration: Advice for employers* (INDG175) asks employers to consider whether there is any alternative way of working without using vibrating equipment. An example of this is given later – see page 7.

Noise control
Noise is a further consequence of drilling into concrete and new legislation, the *Control of Noise at Work Regulations 2005*, came into force in April 2006. Where employees are using powered tools, such as hammer drills, for more than half an hour per day, then the employer is likely to have to comply with the new regulations.

The Regulations require an employer to:
- Assess the risks to their employees from noise at work
- Take action to reduce the noise exposure that produces those risks
- Provide their employees with hearing protection if it is not possible to reduce the noise exposure sufficiently by other methods
- Make sure the legal limits on noise exposure are not exceeded
- Provide their employees with information, instruction and training
- Carry out health surveillance where there is a risk to health

The HSE publication *Noise at work* (INDG362) explains what needs to be done to comply with the Act.

From the list above, it can be seen that the duty of care placed on the employer to control noise levels at work is similar to that for controlling vibration at work.

**List of HSE publications on hand-arm vibration**

*Control the risks from hand-arm vibration: Advice for employers* INDG175 (rev2) HSE Books 2005 - ISBN 0 7176 6117 2

*Hand-arm vibration: Advice for employees* INDG296 (rev1) HSE Books 2005 - ISBN 0 7176 6118 0

These booklets provide information on hand-arm vibration syndrome, its causes and its effects and what the employer and the employee can do to reduce the risk. They are available free for single copies and in priced packs of 10.

*Hand-arm vibration HSG88 HSE Books 1994 - ISBN 0 7176 0743 7*

A handbook with chapters for: managers, safety advisers, safety representatives and machinery suppliers; for engineers and technicians; and for health professionals. It covers: hazard and control programmes; technical ways to reduce vibration; clinical effects and the health surveillance programme; and measuring hand-arm vibration.

*Power tools: How to reduce vibration health risks. INDG338 HSE Books 2001 - ISBN 0 7176 2008 5*

This leaflet is aimed at employers in companies where vibrating hand-held or hand-guided power tools and machinery are used. It is part of a campaign to reduce hand-arm vibration injuries in the workplace by alerting employers to the damage that can be done by vibrating tools and machinery and encouraging them to choose those with low levels of vibration, single copy free or priced packs.

*Vibration solutions: Practical ways to reduce the risk of hand-arm vibration injury HSG170 HSE Books 1997 - ISBN 0 7176 0954 5*

A book of 51 case studies showing how vibration problems were tackled in 16 different industries plus practical guidance on how to approach a vibration problem and how to avoid pitfalls when introducing controls.
Designers have a duty of care to ensure that, as far as is reasonably practicable, projects are designed to avoid, or reduce risks that may arise to those constructing and maintaining a building.

In the CDM Regulations a ‘Duty Holder’, formerly known as a Planning Supervisor in the older CDM Regulations, is entrusted with the overall responsibility for co-ordinating the health and safety aspects of design and initial planning.

As operatives using vibrating hand tools are at risk from HAVS as well as excessive noise and dust, it is the duty of the designer and Planning Supervisor to seek alternative ways of minimising the risk, or preferably avoiding it altogether. Designers are encouraged by the duties of the CDM Regulations to change the design in order to avoid or minimise potential risks.

The Construction Industry Council has issued CDM guidance for designers (Health Guidance Series H20.001) on avoiding musculo-skeletal injury, including HAVS.

The advice for designers is that they should consider:

“Not specifying operations, which require hand-held tools, which vibrate . . .”

The drilling of concrete to provide fixings is a common situation where vibrating hand tools are used. However, there are alternative solutions for providing fixings in concrete that do not involve drilling.

Dust control

Drilling into concrete produces dust that contains crystalline silica. Breathing in silica dust is a health hazard which can lead to the development of silicosis, a lung disease. Under the COSHH Regulations there is a Maximum Exposure Limit (MEL) for respirable crystalline silica of 0.3 mg/m³. However, the HSE has issued Chemical Hazard Alert Notice 35 stating that “. . . there is a much higher risk of lung damage than had been previously thought”. The HSE therefore advise that employers should aim to control exposures to 0.1 mg/m³ (8-hour TWA) or below.

HSE information sheet 36 Silica explains the health effects, the precautions to take and surveillance requirements for employers.

Designing out the risk

Until the Construction (Design and Management) Regulations (known as the CDM Regulations) were introduced in 1994, health and safety issues rested largely with the main contractor. The CDM Regulations extended the duty of care at the pre-site stage to designers and clients.

CDM 2007 is the latest revision of the CDM Regulations and comes into force in April 2007. It has simplified the regulations in order to improve clarity and focuses more on the planning and management of a project rather than the need for paperwork.

Designers have the following duties in relation to health and safety under the CDM Regulations:

- Make clients aware of their health and safety duties
- Give due regard to the effective planning and management of risk at the design stage
- Keep paperwork risk-focused and project specific
- Provide the right information about the health and safety risk to the right people at the right time
- Co-operate with all members of the design team to minimise the health and safety risk
Safe provision of fixings in concrete

In the CDM Regulations, complete avoidance of risk is preferable to minimising the risk. If we consider, in this context, the provision of fixings into concrete, one option is to drill the concrete using a hammer drill. In order to comply with the new Control of Vibration at Work Regulations, an assessment would need to be made to ensure that the time spent drilling by individual workers did not breach the limit of 5.0 m/s² per day. The noise from drilling may also trigger an assessment of noise levels under the Control of Noise at Work Regulations, as well as an assessment of the level of Silica dust under the COSHH regulations.

However, if the design specification were changed to incorporate steel channels cast into the concrete, these could be used to provide fixing points - this involves no drilling into the concrete and therefore no risk of HAVS. It also avoids the noise and generation of Silica dust that accompanies hammer drilling into concrete.

The use of cast-in channels to provide fixings into concrete is a well established alternative to drilled anchor fixings. The channels are rectangular in section and secured in the concrete by means of integral anchors. Each channel is complemented by matching T-head bolts. The channels are fixed to the formwork prior to casting the concrete. When the formwork is struck, each channel provides a slot into which T-head bolts can be fixed in any position along the length of the channel - see opposite.

A wide range of channel sizes and bolt lengths are available to provide the designer with a great deal of flexibility in the design of fixings.

Advantages of cast-in channel

- No reduction in working time due to noise, vibration, or drill operator safety restrictions
- No risk of damaging concrete due to blows from power tools
- No damage to reinforcement
- No concerns about oversize diameter or shallow holes being drilled, reducing load capacities
- Can be cast-in close to concrete edges
- Multiple fixings at close spacings
- Very fast and easy to install with little dependence on skill of the installer
- Instant loading without waiting for chemical resin anchors to harden
- Reduced installation time for subsequent fixings and no need for power supply
- Channel accepts wide range of ties, T-bolts and locking plates
- Channels available in galvanised steel or in stainless steel
- Engineered solution gives confident pull-out strengths

Channels can avoid the need for time consuming surveying and marking of reinforcement (see right) that is necessary before drilling into post-tensioned floor slabs.
Halfen channel showing ease of making fixings

Hot rolled Halfen channels for dynamic loads
- Point loads to 32 kN
- Hot-dip galvanised & stainless
- T-bolt diameter 10-30 mm
- High dynamic capability
- High torques/longitudinal loads

Cold formed Halfen channels for static loads
- Point loads to 25 kN
- Hot-dip galvanised & stainless
- T-bolt diameter 6-20 mm

Halfen channels with toothed lips for longitudinal loads
- High slip loads
- Hot-dip galvanised
- Toothed T-bolt diameters 12-16mm
- High dynamic capability
To enable off-site construction, precast panels can be suspended using channel cast into the concrete structure of the building. Shown here with Halfen’s FPA panel support system.
Typical applications
Some possible applications for Halfen cast-in channels, showing the versatility of the product

**Conclusion**

We are all much more aware of health and safety these days, and rightly so. The Control of Vibration at Work Regulations introduced in July 2005 limits the time that individual operatives can spend using vibrating hand tools. The Control of Noise at Work Regulations 2005 impose similar restrictions to protect employee’s hearing. Furthermore, the CDM Regulations place a duty of care on designers to avoid health and safety risks, such as Hand Arm Vibration Syndrome, excessive noise and dust.

Fortunately there is a ready-made solution. The health and safety issues that arise from hammer drilling concrete for fixings can be avoided completely by the use of channels cast into concrete.
References

Health and Safety Executive

*Hand-arm vibration, HSG88 HSE Books 1994 - ISBN 0 7176 0743 7*

*Vibration solutions: Practical ways to reduce the risk of hand-arm vibration injury, HSG170 HSE Books 1997 - ISBN 0 7176 0954 5*

*Health risks from hand-arm vibration: Advice for employees and the self-employed, INDG126 HSE Books 1998 - ISBN 0 7176 1554 5*


*Silica, HSE Information Sheet No 36*


Useful web addresses:

*www.patient.co.uk/showdoc.asp?doc=23069104 (For symptoms and treatment)*

*www.hse.gov.uk/vibration/hav/index.htm (Information and advice on hand-arm vibration)*

*www.hse.gov.uk/statistics/causdis/vibrate.htm (Scale of disease)*

*www.hse.gov.uk/noise/advice.htm (advice for employers)*

*www.halfen.co.uk (For information on cast-in channels and the full range of Halfen products)*

While every effort has been made to verify the accuracy of this White Paper, Halfen Ltd accept no responsibility for information obtained from other sources.