Hand-Arm Vibration

Sue Hewitt
Health and Safety Laboratory
Health & Safety Laboratory

- Agency of Health and Safety Executive
- Over one hundred years of knowledge and experience
- Widest science base of any equivalent European Laboratory
- Multi-sector, inter-disciplinary capability for the real world of work
HSL

400+ staff:
• Chemists
• Physicists
• Mathematicians
• Engineers
• Microbiologists
• Epidemiologists
• Medical doctors
• Fire experts
• Explosives experts
• Process safety experts
• Ergonomists
• Psychologists…
Who we work for
Content

- Legal duties
  Control of Vibration at Work Regulations 2005
- Assessment of risk
- Practical control of hand-arm vibration
- The role of health surveillance within a programme of risk control measures
What is HAV?

- Hazardous exposure to HAV arises from use of:
  - hand-held
  - hand-guided, or
  - hand-fed machines
What is HAV?

Which industries?

- Construction
- Heavy engineering & fabrication
- Shipbuilding/ship repair
- Foundries
- Stone working
- Grounds & estate maintenance
- etc…
What is HAVS?

Hand-arm Vibration Syndrome (HAVS)

- all-encompassing term describing the signs and symptoms of disorder caused by vibration exposure

- HAVS consists of three components
  - Vascular
  - Neurological
  - Muscular and soft tissue

- Each component may occur independently
What is HAVS?
What is HAVS?

IIDB - Industrial Injuries Disablement Benefit

Case Numbers


- Vibration white finger
- Carpal tunnel syndrome
- Occupational deafness
What is HAVS?

IIDB - Industrial Injuries Disablement Benefit

• IIDB requires significant disability
• Civil compensation
  – Direct costs: £5,000 to £20,000 per person.
  – Indirect costs 8 – 30 times more
• HSE: “HAVS is serious and disabling, and nearly 2 million people are at risk”
What is HAVS?

Serious, disabling and costly … … but preventable
CVWR 2005

The Control of Vibration at Work Regulations 2005

• National implementation of the European Physical Agents (Vibration) Directive (Directive 2002/44/EC)
• Employer’s duty to assess and control risks from vibration (hand-arm and whole-body)
• Came into force on 6 July 2005
CVWR 2005 – Action/Limits values

- Exposure Action Value (EAV)
  2.5 m/s² A(8)
  - not a “safe” level of exposure

- Exposure Limit Value (ELV)
  5 m/s² A(8)
At any exposure level

- Assess vibration risks to health and safety
- Eliminate vibration risk at source, or reduce to lowest reasonably practicable level
- Provide information and training for employees
If the exposure action value (EAV) is likely to be exceeded

*Daily exposure of 2.5 m/s² A(8)*

- Programme of organisational and technical measures to reduce exposure to lowest level reasonably practicable
- Health surveillance programme
CVWR 2005 - Employer’s Duties

Above exposure limit value (ELV)

Daily exposure of $5 \text{ m/s}^2 \text{ A}(8)$

- Ensure employees are **not** exposed above the ELV
- If they are, take immediate action to prevent recurrence
Employers have duties to:

Assess

Control

Information, Instruction and training

Record & Monitor
ASSESS - Risk assessment

Assessment enables management of risk

Only adequate if it provides enough information to enable you to take appropriate action.
ASSESS — General approach

Look for evidence of risk:

- Industry/process/tools with known HAVS risk?
- Significant daily operating time?
- Tingling, etc. during/after tool use?
- HAVS symptoms in workforce?

Look for solutions:

- Industry good practice?
- Can more be done?
ASSESS - Rule of thumb

<table>
<thead>
<tr>
<th></th>
<th>MEDIUM RISK</th>
<th>HIGH RISK</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>More than 1 hour</td>
<td>More than 4 hours</td>
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<td><img src="image1.png" alt="Image" /></td>
<td><img src="image2.png" alt="Image" /></td>
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<tr>
<td>More than 15 minutes</td>
<td></td>
<td>More than 1 hour</td>
</tr>
</tbody>
</table>
Discuss:

- What information do you need to use the rule of thumb?
- What is the likely risk in this case?
ASSESS - Exposure evaluation

**Vibration magnitude:**

- equipment manufacturers
- trade associations
- consultants
- databases
- workplace measurement

![Graph showing vibration magnitude for various tools](image)
Vibration is measured in **three axes**

Each axis is frequency weighted **Wh weighting**

![Graph showing weighting factor against frequency](image)
3 frequency-weighted axes are combined to give:

\[ \text{vibration total value: } a_{hv} \]

\[ a_{\text{Total value}} = \sqrt{a_x^2 + a_y^2 + a_z^2} \]

**Vibration Total Value** is normally reported.
ASSESS - Measurement

First decide what needs to be assessed:

• For each worker or task - identify:
  • Machines or tools used
  • Materials worked

• Take account of:
  • Operating modes
  • Accessories (bits, abrasive grades …)
  • Postures, Forces, Environment (temp, noise)
  • Human factors – experience, motivation fatigue

Observe the process first and decide on your approach
ASSESS - Measurement
ASSESS - Exposure evaluation

• Need vibration *emission* from the tool(s)

• Also *time* of exposure
  – *trigger time* or *contact time*
  – NOT *total task time*

• Combine to obtain daily exposure $A(8)$ in m/s²
ASSESS - Daily exposure

Magnitude, exposure time and daily exposure

![Graph showing vibration magnitude and exposure time relationships]

- A(8) = 10 m/s²
- A(8) = 8 m/s²
- A(8) = 5 m/s²
- A(8) = 2.5 m/s²
- A(8) = 1 m/s²
ASSESS - Daily exposure

Vibration magnitude $a_{hv}$ in m/s²

Daily vibration exposure

Duration $T$ in hours

$$A(8) = a_{hv} \sqrt{\frac{T}{8}}$$

Alternatively, use the calculator at:

www.hse.gov.uk/vibration
**HAND-ARM VIBRATION EXPOSURE CALCULATOR**  
Version 4 June 2013

<table>
<thead>
<tr>
<th>Tool or process name</th>
<th>Vibration magnitude m/s² r.m.s.</th>
<th>Exposure points per hour</th>
<th>Time to reach EAV 2.5 m/s² A (8)</th>
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**Instructions for use:**

- Enter vibration magnitudes and exposure durations in the white areas.
- To calculate, press <Enter>, or move the cursor to a different cell.
- The results are displayed in the yellow areas.
- To clear all cells, click on the 'Reset' button.
- Tick the 'Lock tool or process name' check box to prevent 'Reset' clearing these cells.
- For more information, click the 'Help' button.

[www.hse.gov.uk/vibration](http://www.hse.gov.uk/vibration)
# Hand-Arm Vibration Exposure Calculator

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Exposure likely to be below 2.5 m/s² A(8) EAV (100 points).

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## Daily exposure m/s² A(8)

|                          | 1.8 |

## Total exposure points

|                          | 54  |

## www.hse.gov.uk/vibration
### HAND-ARM VIBRATION EXPOSURE CALCULATOR

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#### WARNING:

- Exposure likely to be above 2.5 m/s² A(8) EAV (100 points)

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[www.hse.gov.uk/vibration](http://www.hse.gov.uk/vibration)
ASSESS - Points method

- Simple
- Additive
- Point per hour/task/process
- Helps exposure management

\[
100 \text{ points} = \text{EAV} \\
400 \text{ points} = \text{ELV}
\]
CONTROL

Reduce **risks** to the lowest level reasonably practicable

Based on assessment and action plan
The emphasis in the vibration regulations is on control.

In many cases a risk assessment will be essential to indicate the options for an action plan to control or manage exposure.

HSE is asking for evidence of the action plan, and that the key measures identified are being implemented.

Hand-arm vibration
The Control of Vibration at Work Regulations 2005
CONTROL: Hierarchy

Elimination
Change the process

Substitution
Low-vibration machines

Engineering Control
Modify machines / processes

Administrative Control
Training, Maintenance, Time limits, job rotation

PPE (?)
CONTROL: Elimination

Machine-mounted pick replaces hand-operated breakers
CONTROL: Process change

Foundry furnace lining removal

Old: Pneumatic pick
Slow process with exposure to vibration, noise, dust, heat

New: Hydraulic push-out
Safer process with shorter furnace down time
CONTROL - Tool Selection

Choose the right powered hand-tool

- Vibration can be very different between tools
- An under-powered or inefficient tool can increase vibration exposure
- Consider the vibration emission of the suitable tools
CONTROL - Tool Selection

• Reduced vibration tools available include:
  – Chainsaws
  – Grinders
  – Breakers
  – Chipping hammers
  – Needle scalers

• More efficient tools can reduce exposure

• Tool maintenance can prevent increased vibration
Grinders demonstration
CONTROL - Suppliers information

• Suppliers must warn of vibration risk

• Suppliers must declare vibration emission
  – or state that it is below 2.5 m/s²

• Manufacturers’ information:
  – Can help identify (and avoid) unusually high vibration equipment
  – Standard emission data is sometimes poor for estimating exposure
  – Supplementary data on residual risk should help
CONTROL — Suppliers’ information

Standardised tests:

• Can appear artificial
• Repeatable & reproducible
• Try to represent real use
CONTROL - Engineering design

Fettling eliminated or reduced by improved casting quality

Green sand casting  →  Lost foam casting
CONTROL - Administrative

Specify maximum exposure times

• Job rotation
  – Share exposures and non-vibration tasks

• Need to consider
  – Productivity – what are you asking the workers to do?
  – Do bonus/pay systems encourage certain types of working practice

• Need to communicate and supervise

But

• Not as effective as reducing vibration magnitude
CONTROL - Administrative

Regular maintenance program

• Return tool policy
• Raise awareness of the risks from poorly maintained tools
• Attachments
  – Suitability
  – Sharp
  – Replacements
Anti-vibration gloves are available, but:

- A-V Gloves reduce vibration at 300Hz and above
- Most power tools operate at 30-150Hz (1800 – 9000rpm)

Therefore:
- Unlikely to reduce HAV exposure

**DON’T:** Rely on gloves to control vibration risks

**DO:** Keep operators warm and dry (hands, arms & body)
Information, Instruction & Training

**Information** on HAV risk and symptoms

**Instruction and Training** on using the systems for minimising risk
Information and training

• Raise awareness (risks, controls, symptoms)
• Explain the purpose of health surveillance
• Ways to minimise risk:
  – working practices to reduce vibration exposure (tool selection and maintenance)
  – correct techniques for equipment use (grip, push and strain)
• Personal care
  – Keeping warm and dry
  – Wear warm clothes and gloves
  – Maintaining circulation
Information and training

Proper training in machine use:

- How to plan the job
- What forces to apply
- Proper techniques

“C’mon! Keep those stomachs over the handle! Let the fat do the work! …That’s it!”
Information and training

Example
Vibration-reduced breaker:

– Keep the moil point sharp
– Break a little at a time, don’t get jammed
– Don’t force anti-vibration handles
– Stop breaker before pulling out
Sander demonstration
Recording & Monitoring

Record what you do

Monitoring that it remains effective

Use health surveillance
RECORD

• Tasks Assessed
• Risk of HAVS for employees
• Likelihood of exposures above EAV & ELV
• Controls measures
  – Current
  – Future plans
• Training and instruction and information
• Scheme of health surveillance
MONITORING

• Check control measures for:
  – effectiveness and
  – continuing relevance

• Use health surveillance to:
  – provide feedback on success (or problems with) the control programme.
MONITORING

Health surveillance

When?

- exposure action value exceeded

and/or

- risk assessment shows the need
MONITORING

Health surveillance

Purpose?

• Identify those at particular risk
• Identify HAVS an early stage
• Prevent disease progression and disability
• Help people stay in work
• Check the effectiveness of vibration control measures
SUMMARY

Risks from hand-arm vibration exposure are: Serious, disabling and costly … but preventable

• **Assessment:**
  – Rule of thumb, manufacturer’s data, HSE spreadsheet

• **Control:**
  – Elimination, reduction, engineering & administrative controls

• **Information, Instruction and Training:**
  – Ensure controls are operated correctly

• **Health surveillance:**
  – Integral part the programme of risk control and monitoring measures
  – provides important feed-back to management of risk
Any Questions?

www.hse.gov.uk/vibration/hav