Control of occupational exposure to vibration in the UK
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Prior to the 2005 Regulations

• Much UK industry activity on HAV
  – Response to civil claims
• Manufacturers’ HAV information confusing
• Little industry awareness of WBV
  – Interest from industries with back pain
• Manufacturers’ WBV information scarce

Control of Risks from Hand-arm Vibration
HSE guidance and expectations
Hand-arm vibration

Hand-arm vibration syndrome (HAVS)

- Serious, disabling and costly …
- … but preventable

UK action before the Regulations - HAV

- Industry responding to cases of VWF
  - RIDDOR and IIDB mid 1980s
- Action in high exposure industry
  - Heavy industry, construction, etc.
- Legal requirement to control risk supplemented by HSE guidance from 1994
HSE’s approach since 1994

- Inspect workplaces for control of exposure
  - HSE guidance and general law until 2005
  - Control of Vibration at Work Regulations after 2005
    - (UK implementation of 2002/44/EC)
- Inspect suppliers for lower vibration tools and information about vibration risk
  - Supply of Machinery (Safety) Regulations
    - (UK implementation of 98/37/EC)

European exposure criteria 2005

- 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)
  - higher than HSE’s 1994 recommended action level
  - a difficult challenge for some sectors of industry

Rough guide to exposures

- Rotary tools
  - EAV exceeded within 1 hour
  - ELV exceeded within 4 hours
    - Some tools exceed ELV within 1 hour
- Percussive tools
  - EAV exceeded within ¼ hour
  - ELV exceeded within 1 hour
    - Some tools exceed ELV within 2 or 3 minutes
* Note: These are ‘trigger times’
HSE's Priorities

- Target interventions at industries where there are:
  - high exposures; and/or
  - large numbers of people at risk
- To minimise the number of exposures above the ELV by 2010:
  - ensure the application of established good practice; and
  - encourage the development of good/better practice where required

The Vibration Regulations - employers' duties

- Ensure health and safety of employees
- Risk assessment
- A hierarchy of measures to achieve control
- Information, instruction and training for employees
- Health surveillance if required
- Expected in UK for HAV since 1994, under general H&S legislation and HSE guidance on HAV (HSG88)

Duties of employers (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 on vibration risks and control measures
Duties of employers when exposure likely > 2.5 m/s² A(8):

- Reduce exposure to the lowest reasonably practicable level; and
- Introduce health surveillance

Duties of employers: the exposure limit value

- Ensure employees are not exposed above the ELV
- If they are, take immediate action to prevent recurrence
- Note: transitional period until July 2010 for the ELV where:
  - equipment in use before 6 July 2007; and
  - not (yet) reasonably practicable to comply with ELV

Who is exposed to HAV?
(from Medical Research Council study, 1999)

- About 5 million exposed to HAV at work
- About 1.7 million exposed above EAV
- About 1 million exposed above ELV
- Greatest numbers in construction industry and related trades
- Highest levels of exposure in heavy fabrication, foundry fettlers, stone masons
HAV risk assessment

• Look for evidence of risk:
  – Industry/process/tools with known HAVS risk?
  – Significant daily operating time?
  – HAVS symptoms in workforce?
  – Tingling, etc. during/after tool use?
• Look for solutions:
  – Good practice being applied?
  – Can more be done?

Exposure assessment

• Get vibration information from reliable sources:
  – equipment manufacturers (declared emission and other information)
  – other sources of relevant vibration data
  – workplace measurements if necessary
• Look for corroboration between sources
• Is exposure likely to be above action value?
• Is exposure likely to be above limit value?

Control of exposure

• Change the process
  – eliminating or reducing vibration exposure at source;
  – often essential where exposures are very high.
• Select suitable (reduced-vibration) equipment
  – purchasing policies
• Operator training
• Maintenance of equipment
• Time limits, job rotation
  – exposure points system may help
Case study: changing the process
Mechanisation removes the risk

- Machine-mounted pick replaces hand-operated breakers

Case study: changing the process
Demolition without vibration

- Use hydraulic crushers instead of demolition hammers

Case study: changing the process
Fettling eliminated by improved casting quality

Green sand casting → Lost foam casting
Old: Pneumatic pick  
Slow process with exposure to noise, vibration, dust, heat

New: Hydraulic push-out  
Safer process with shorter down time and reduced long-term cost

Choose a suitable tool

- Vibration can be very different between tools
  - But differences greatly reduced in recent years
- An under-powered or inefficient tool can increase vibration exposure
- Compare vibration emissions and exposures for suitable tools

Selecting new equipment

- Choose the right tool for the job
  - safety, economy, efficiency
- Compare standardised vibration data
  - Recent (2006/42/EC) or supplementary data should be suitable for exposure assessment
- Use information to avoid risk of HAVS
  - Operator training requirements
  - Maintenance requirements
  - Consumable selection
Suppliers can help

- Manufacturers’ information:
  - Must warn of vibration risk
  - Helps identify unusually high vibration equipment
    - Standard emission data
      - Avoid unnecessary vibration
    - Information for safe use should prevent HAVS
- Suppliers must declare vibration emission
  - or state that it is below 2.5 m/s²

Information, instruction and training for operators

- Correct selection of equipment
- Correct operation of equipment
  - especially important with many vibration-reduced designs (suspensions)
- How to recognise (and report) symptoms of HAVS
- Help minimise risk (keeping warm and dry, exercising fingers, breaks from exposure, not smoking, etc.)

Operator training requirements

- 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
Controlling daily exposure

- Limit daily exposure durations
- Job rotation
- Exposure points system:
  - EAV = 100 points
  - ELV = 400 points
  Points can be added - easier to calculate and record exposures

HAV exposure points: ready-reckoner

- All values are exposure points
- Colours show exposures re. EAV & ELV

“Traffic lights” system

- Some tool suppliers and hirers have established a three colour system of tool classification:
  - **Green**: any combination of green tools can be used for up to 8 hours (before ELV likely to be exceeded)
  - **Amber**: any combination of amber and green tools can be used for up to 2 hours (before ELV likely to be exceeded)
  - **Red**: refer to supervisor (use of points system recommended)
- Construction industry enthusiastic
- HSE working with industry to improve quality of vibration data and accompanying guidance
Health surveillance

- Required when the EAV is likely to be exceeded
  - or where risk assessment shows the need
- Important for HAVS because:
  - Some high exposures are unavoidable;
  - There is no effective personal protective equipment

Purpose of health surveillance

- To identify any vibration-related disease at an early stage
  - The EAV is not a safe level
- To help prevent disease progression and disability
- To check the effectiveness of the employer’s control measures
When to carry out health surveillance

- Employees likely to be regularly exposed above EAV
- Employees occasionally exposed above EAV where the risk assessment identifies that the frequency and severity may pose a risk to health
- Employees who have a diagnosis of HAVS even if exposed below EAV

The occupational health provider – what to expect

- Competent health professionals with appropriate qualifications and training
- Doctors - Diploma, Associate or Member of the Faculty of Occupational Medicine
- Nurses – Diploma or Degree in Occupational Health or an MSc
- Faculty of Occupational Medicine (FOM) syllabus of approved HAVS training and qualification (from 2005) or equivalent level of competence

What the employer needs to do – communication and records

- Consultation with employees and safety or employee representatives
- Agreed policy – What happens when fitness for work is an issue
- Training (explanation of symptoms)
- Health records (fitness outcome)
Tiered approach

- A screening tier may help employer keep costs down
- Chosen tier of investigation matches what is known about health status
- Helps minimise demand on limited specialist nurse and doctor resource

Tiered approach

- Tier 1 Pre-exposure baseline
- Tier 2 Annual screening
- Tier 3 Clinical assessment
- Tier 4 Formal diagnosis
- Tier 5 Optional standardised tests

Tier 1 Pre-exposure baseline

- Simple questionnaire to ask whether there are symptoms
- If any symptoms, refer to occupational health professional
- If employee has HAVS, are they fit for work with HAV?
**Tier 2 Annual screening**

- Self-administered questionnaire about symptoms, e.g. tingling, whiteness on exposure to cold
- If agreed, can be non-confidential
- Option to have a ‘Responsible Person’ who:
  - Has confidence and cooperation of employees
  - Can explain how the screening system operates and describe symptoms
  - Trained – but not qualified to interpret symptoms
- Reporters of symptoms referred to Tier 3

**Tier 3 Clinical assessment**

- Does the employee have HAVS?
- How severe are the symptoms?
  - Stage 1 on Stockholm Scale least severe
  - Stage 3 on Stockholm Scale most severe
- Qualified person to conduct interview and examination
  - Occupational health nurse

**Tier 4 Diagnosis**

- Formal diagnosis
  - Responsibility of the doctor
- Fitness for work decision
  - Prevent loss of hand function
    - Tier 5 SN tests can be useful
    - Remove from exposure at late Stage 2
  - No cases to reach Stage 3
- Medical records are confidential
  - Stage of disease disclosed only with consent
What the employer should receive from health surveillance

- Fitness status
  - Fit/unfit/fit with restrictions for work with HAV
  - Advice on compliance with restrictions
- Date of next review
- Anonymised feedback of group results
- If employee has agreed, details of severity (Stage on Stockholm Scale SN, V)

What the employer should do in response to the results

- If employee no longer fit, consider alternative work without exposure to HAV
- If employee is fit but has HAVS, consider reducing exposure, taking into account any advice on restrictions
- If any employee develops HAVS or more severe symptoms appear, review risk assessment and controls.
- Report new cases under RIDDOR.

Summary - HAV

- The opportunity to reduce vibration risk should be assessed
- Controls should be put in place to eliminate vibration risk at source, or reduce it to lowest reasonably practicable level
- Employees should be provided with information and training on the risks and control measures
- Health surveillance should be used to ensure the controls are working
HSE’s guidance

- www.hse.gov.uk/vibration
- Employees’ pocket card
- Employers’ leaflet

www.hse.gov.uk/vibration

Any questions?
Essential Health & Safety Requirements (EHSRs) for Free Trade in Europe - application to vibration

The benefits of HAV control at source

• User modifications to hand-tools not advised

• Control of vibration at source
  – Re-equipment assures widespread improvements
  – Long term, sustainable results

• HSE inspection of suppliers delivers:
  – Awareness of vibration issues
  – More demand on manufacturers for low vibration products

HSE strategy for low vibration at source

• Create demand for quality N&V information in workplaces
  – Guidance for employers
  – HSE inspections of workplaces
  – Etc.

• Inspect suppliers for quality HAV information
  – Seek adequate quality in European Standards supplementing the Machinery Directive
    • Join ISO and CEN Working Groups
    • Work with CEN Consultants
    • Evaluate published Standards
EHSRs relevant to vibration

- MD 98/37/EC
  - Article 2 - must be safe
    - 1.1.2(b)(c)(f) Principles
    - 1.5.9 Vibration
    - 1.7.2 Residual risk
    - 1.7.4 Instructions – inc. info for safe use
    - 2.2 HAV emission
    - 3.2.2 Seat minimises WBV
    - 3.6.3 WBV emission

- MD 2006/42/EC
  - Article 4 - must be safe
    - 1.1.2(b)(c)(e) Principles
    - 1.5.9 Vibration
    - 1.7.2 Residual risk
    - 1.7.4.2(h)(k)(l)(n)(r) Information for safe use
    - 2.2.1.1 HAV emission
    - 3.6.3.1 WBV emission

Presumption of conformity

- Equipment produced to harmonised Standards presumed to meet EHSRs
  - Safeguard clause procedures where Member State finds unsafe machinery
  - Procedure for Member States to dispute adequacy of a harmonised Standard
- Not mandatory to use harmonised Standards

Evolution of supply law - HAV

- 1986 ISO 5349 – how to measure HAV – single axis
- 1988 ISO 8662 series – HAV of powered hand tools
- 1992 SM(9)/R - EHSRs
- 2000 EN 792 series – Safety of powered hand tools
- 1999 EN 50144 series – HAV of electric hand tools
- 1998 Vienna agreement – CEN to adopt ISO where possible
- 1997 Machinery Directive 98/37/EC
- 2001 EN ISO 5349-1&2 – how to measure HAV – tri-axis
- 2005 EN ISO 20643 – model for HAV test codes
- 2006 Machinery Directive 2006/42/EC
- 2006 EN 60745 series – revision of 50144 series
- 2008 EN ISO 28927 series – revision of 8662 series
- 2009 Revised SM(9)/R
Some European thinking

- Machinery and draft Physical Agents Directives intended to work in harmony
  - MD 89/392/EEC required providing of vibration advice
  - PAD 2002/44/EC assumes use of manufacturers’ advice
- Manufacturers to write Standards elaborating MD
  - To embrace ‘safe use’ principle of MD
    - Has taken time for principles to embed
      - EN 20643:2005 set goals for HAV test codes
      - Revision of EN 12786 will set goals for vibration clauses in safety Standards

Progress with HAV in the UK

- Late 1980s
  - Poor sales of available reduced vibration tools
  - Some low vibration designs had poor efficiency
- Mid 1990s
  - Manufacturers preparing HAV Standards
    - Poor guide to risk, OK for comparing tools
    - Vibration emissions of competing tools varied by 6:1
- Early 2000s
  - Big customers seek low vibration tools with good HAV data
- Mid 2000s
  - Some good tools with good information on HAV risk
    - ‘Low vibration’ marketing by manufacturers, hirers, etc.

HAV data for power tools: findings 2006-8

- Similar tools, similar vibration emissions
  - 12% of tools had unusually high vibration
- 44% of tools had poor emission declaration
- 50% of tools had poor info on vibration risk
- 37% of tools had poor info for safe use
- Importers demanding better from suppliers
- Trade assocs oppose going beyond Stds
- Turn away from harmonised Standards
The future

- Revised Standards and law are coming into play
  - Residual HAV risk expected to be reduced or eliminated
  - Declaration and verification of HAV emission is clearer
- HAV information for safe use
  - Needed while tools require special operator techniques
    - e.g. handle suspensions need correct range of feed force
  - Weak in cases where information necessary

Any questions?

Worker compensation for vibration injury in the UK
**State scheme**

- Industrial Injuries Disablement Benefit Scheme
- Industrial Injuries Advisory Council (IIAC)
  - Advise government on the prescription of diseases (amongst other things)
- No fault compensation
  - Risk of disease high in occupation compared with general population
  - Occupation cause established (or reasonably certain) for each case

**Civil compensation**

- Under civil law
  - Balance of probability
- Employers shown liable
- Usually referred to insurers

**HAVS**

- State compensation
  - Specified intense blanching of the skin OR
  - Reduction in sensory perception and dexterity
  - Specified types of job
- Civil compensation
  - Agreed amongst interested parties OR
  - Decided by court on evidence of attributable consequences of exposure to HAV
Carpal Tunnel Syndrome

• State compensation
  – Diagnosed carpal tunnel syndrome
  – Use of hand-held power tools or specified persistent and frequent flexion of the wrist

• Civil compensation
  – Agreed amongst interested parties OR
  – Decided by court on evidence of CTS and attributable consequences

Any questions?

Control of Risks from Whole-body Vibration
HSE guidance and expectations
Whole-body vibration

Prior to the Regulations - WBV

- Minimal industry experience of WBV injury
- Concern at initial proposals for ELV
  - $0.7 \text{ m/s}^2$ $A(8)$ 3-axis sum became $1.15 \text{ m/s}^2$ $A(8)$ single axis
- Much interest/concern in road transport
- Willingness to study WBV in off-road industries

Much learned about WBV

- Exposures above EAV in most off-road work
- Few exposures likely above ELV
- Good management practice provides adequate control of WBV at minimum cost in most circumstances
- Careful selection of machinery, seats, routes, speeds required in some specialist activities
Back pain in drivers

- Many possible causes of back pain in drivers:
  - Poor design or adjustment of seating or controls
  - Poor driver posture
  - Long periods in seat
  - Manual handling of loads
  - Awkward access to/jumping from cab
  - WBV, especially shocks & jolts
  - Non-occupational causes

Suspension seats

- Step change in employers’ maintenance of suspension seats
- Selection of machinery with optimum seat suspension for intended use remains trial and error
  - Standard criteria for seat does not ensure optimum compatibility with the machine

HSE’s holistic approach to back pain

- WBV is not the only source of back pain
- Check sources and prioritise controls
  - Is WBV aggravating existing back injuries?
  - Assess posture, access or sitting for long periods
  - Assess manual handling of loads
  - Monitor health and analyse for trends and source
Exposure criteria for WBV

- Exposure Action Value (EAV): \(0.5 \text{ m/s}^2\ A(8)\)
  - many vehicle/mobile machinery users will need to consider WBV, but actions will often be simple good practice
- Exposure Limit Value (ELV): \(1.15 \text{ m/s}^2\ A(8)\)
  - An issue for some activities in quarrying
  - Transitional period for ELV to 2010 if not currently reasonably practicable to comply
- HSE guidance criterion for risk: \(17 \text{ m/s}^{1.75}\)
  - International consensus on clear risk from WBV

Vibration evaluated in three directions

- Vibration exposure evaluated separately in each of 3 directions
  - Not summed like HAV
  - x or y-axes can dominate
    - Suspension seat beneficial in z-axis

HSE’s guidance on WBV

- Employees’ pocket card
- Employers’ leaflet for
- Guidance on the Regulations and WBV (L141)
- Industry specific guidance where WBV may contribute to back pain
  - Agriculture, Forestry, Quarries, Sea ports, Road haulage, etc.
Manufacturers' vibration information - WBV

- Earth mover manufacturers have produced a description of likely vibration ranges
  - Agricultural machinery manufacturers producing similar information
    - Tractors seats long met vibration spec.
- Some manufacturers set out good practice for control of WBV
- Few machine specific vibration test codes

Example exposure data

- EU guide
  - Contains example workplace emission data for many machines and applications
  - Exposure above the EAV for virtually all machines

HSE WBV Information Sheets

- Industry specific good practice
- Industries where high rates of back pain
  - WBV not necessarily the main cause
    - Agriculture
    - Forestry
    - Sea ports
    - Construction, demolition, etc.
    - Quarries
    - Industrial truck users
    - Road haulage
- To be published on the web
**WBV exposure categories**

- **Precautionary measures advisory:**
  - Exposure < EAV, No significant shocks

- **Precautionary measures mandatory:**
  - Exposures > EAV, No significant shocks

- **Control measures essential:**
  - Exposures > EAV, Significant shocks likely
  - VDV > 17 m/s\(^{1.75}\) Risk of WBV or shocks causing back pain.

- **Restriction of exposure mandatory:**
  - Unchecked exposures >ELV

**WBV – HSE expectations 1**

- Operators trained in risks and controls
- (Suspension) seat in good condition
  - Defective/insufficient dampers cause shock
    - Replace several times during seat's life
  - Seats replaced several times in life of machine
- WBV similar in directly competing machines
  - More high WBV in artic. than rigid dumpers
  - Adequate power/capacity machines for job

**WBV – HSE expectations 2**

- Ground condition adequate for machinery using it
  - Regular grading
- Modify speed and route to avoid excessive WBV
- Job rotation can help meet ELV
  - Job rotation helps reduce average exposure
    - Will not reduce risk from shock
  - Eliminate shock before using job rotation
Summary - management of WBV risks

- Consider all contributors to ill-health, not just vibration
- Consider risk from shocks and jolts
- Most industries should be able to adopt sector-specific guidance on good practice

www.hse.gov.uk/vibration

Any questions?
For more information

HSE guidance L140 and L141
www.hse.gov.uk/vibration
EU guidance –
www.ec.europa.eu/employment_social

Thank you