NERC HEALTH & SAFETY PROCEDURE NUMBER: 37

CONTROL OF VIBRATION HAZARDS AT WORK

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1. PURPOSE and BACKGROUND

1.1 This procedure seeks to ensure the risks from exposure to vibration, whether to hands and arms or to the whole body, are adequately controlled. Where employees are likely to be exposed to vibration at or above the relevant exposure action or limit values, measures and adequate controls to ensure the risk of persons suffering harm from vibration is eliminated, minimised or adequately controlled must be implemented.

1.2 Hand arm vibration (HAV) is a potential hazard for employees who work with hand held tools, hand guided machinery or feed work by hand to a machine where this exposes their hands and arms to high levels of vibration. Prolonged and regular exposure to excessive levels of HAV can affect the operator's health in particular causing Hand Arm Vibration Syndrome (HAVS), of which the best known condition is Vibration White Finger (VWF).

1.3 Whole body vibration (WBV) is mainly concerned with large shocks or jolts when there is a risk of injury to the back and usually applies to workers in the sitting or standing position when travelling in mobile machinery over rough surfaces for extended periods.

1.4 Prolonged exposure to excessive levels of vibration can cause incurable conditions and severely affect the sufferer's ability to continue work and the quality of their life. The amount of injury is related to the magnitude of vibration generated by the work equipment, the duration of the exposure and other factors such as the method of work, workplace temperature and damp or windy conditions.

1.5 Some persons who suffer from certain medical conditions such as diabetes, circulatory or nervous disorders are at increased risk of developing HAVS. An individual's health status and any medication must be taken into account when considering the adverse effects of HAV.

2. SCOPE

2.1 This policy applies to all work within NERC where there is a risk of elevated levels of exposure to HAV or WBV. In particular this includes work with powered hand-held tools (such as grinders, hammer drills, band saws, hedge trimmers or strimmers), hand guided machinery (such as lawnmowers, plate compactors or 'wackers', chain saws, strimmers) and hand fed machines (such as pedestal grinders where the material being acted on by the machine is being held or fed by hand grip). For WBV, it will especially apply to work activities where the body is exposed to high

levels of shock or vibration especially where persons drive vehicles off-road or across rough surfaces. It also potentially concerns ships and some aircraft; although measurements show it is highly unlikely the exposure action value will be exceeded.

It is possible that high-speed travel over rough water using power boats or Rigid Inflatable Boats (RIBs) can generate high levels of whole body vibration.

3. REQUIREMENTS

3.1 No-one within NERC may be exposed to HAV or WBV at or above the relevant Exposure Limit Values (ELV) as specified in the Control of Vibration at Work Regulations 2005 (CoVaWR) and listed below. If exposure is likely to reach the Exposure Action Value (EAV) under CoVaWR, a risk assessment must be undertaken and measures implemented which prevent or adequately control exposure to vibration and reduce the daily vibration exposure, A(8), to as low a level as is reasonably practicable.

3.2 Exposure Limit Values and Exposure Action Values

HAV

Daily exposure limit value (ELV) = **5 m/s^2** A(8)

Daily exposure action value (EAV) = **2.5 m/s^2** A(8)

Ascertained using the basis set out in Schedule 1 Part 1 of the CoVaWR.

WBV

Daily exposure limit value (ELV) = **1.15 m/s^2** A(8)

Daily exposure action value (EAV) = **0.5 m/s^2** A(8)

Ascertained using basis set out in Schedule 2 Part 1 of the CoVaWR.

Weekly Exposure Values

Weekly exposure values may be used where the exposure to the employee from vibration is usually below the EAV but varies markedly from time to time and may occasionally exceed the EAV. This is subject to the following provisos:

- The exposure to vibration averaged over the week is less than the ELV
- There is evidence to show the risk from the actual pattern of work is less than the corresponding risk from constant exposure at the ELV
- The risk is reduced to as low as is reasonably practicable, taking into account the special circumstances
- The employees concerned are subject to increased health surveillance if appropriate

The Weekly Exposure ($A(8)_{week}$) is the total exposure occurring within a period of seven consecutive days, normalised to a reference duration of five 8-hour days (40 hours) and ascertained using the formula given in Schedule 1 Part II for HAV and Schedule 2 Part II for WBV.

3.3 A risk assessment will identify the likely levels of exposure and include observing the work and the conditions of the workplace, obtaining relevant information and data on the likely magnitude of vibration under the methods used, the duration of use ('trigger time') within any working day. In addition, it is

necessary to identify any staff whose health is at particular risk from vibration (see section 3.23 – 3.27). Guidance on risk assessment is given in Appendices 3 (for HAV) and 4 (for WBV).

3.4 The control of vibration risk will ideally be achieved by using machinery and equipment which produces lower levels of vibration, by restricting the duration of exposure, by maintaining equipment, by modifications to the working conditions which help prevent an adverse environment and by use of Personal Protective Equipment. Health surveillance and awareness training will also be important.

Hand Arm Vibration

3.5 To help identify if there is a HAV problem to manage, the following questions should be asked:

- Are rotary action power tools used for more than about an hour per day?
- Are hammer action tools used for more than about 15 minutes per day?
- Is the area of work one where occurrence of HAVs is known to be a problem?
- Is the work within an area where there are industrial processes for which HAVS is reportable under RIDDOR? (see note at end of Appendix 3)
- Do any suppliers of equipment you use warn of a vibration risk
- Do any employees have symptoms of HAVS?

3.6 If the answer to any of the above questions is ‘yes’ then it should considered there may be a problem from HAV and the following steps should be taken:

- All existing powered tools, equipment and machinery which potentially pose a risk of hand arm vibration are to be identified (see Appendix 5 for some examples of high risk equipment and ranges of magnitude of vibration levels)
- Conditions of use of such powered tools, equipment and machinery are to be reviewed and observed to obtain a true and representative appreciation of the nature of the work
- The maximum duration of their use (‘trigger time’) in any working day is to be identified, if necessary by keeping diaries or using special monitoring devices
- Data obtained as to the magnitude of vibration to the hands and arms they may produce either from the manufacturer, from a recognised test house who has conducted tests under realistic or actual working conditions or by direct measurement of the tools, equipment or machinery
- Where manufacturer’s data is used, this may have been determined from laboratory tests conducted under ideal conditions that do not reflect real conditions of use. Where there is any doubt, a multiplier of 2x should be applied to the manufacturer’s figures to obtain a better estimate of real life worst case exposure.
- Likely daily levels of exposure by staff from HAV are to be calculated using the methods explained in Appendix 4

3.7 If it is considered there is no risk from HAV and the relevant EAV for HAV is unlikely to be exceeded, this should recorded and users informed of the conclusion there is no risk and provided with any information which supports or ensures this.

3.8 Where there is a likelihood the HAV EAV will be exceeded, a written risk assessment should be undertaken which identifies risk reduction procedures to eliminate exposure at source or reduce exposure to as low a level as is reasonably practicable and ensures the ELV is not exceeded. This could be by restricting the duration of operation in any working day, by replacing existing hand held tools with newer equipment that posses a lower risk of vibration, by maintaining or modifying the equipment or working methods to reduce exposure to vibration etc.

3.9 Even where the EAV is not likely to be exceeded, it will be necessary to identify any individuals whose health is at elevated ('particular') risk and take measures to ensure they are not placed at risk from vibration.

3.10 Hand held, hand guided or hand fed equipment which exposes staff to a HAV magnitude of less than 2.5 m/s^2 should not necessarily be considered safe, especially if the exposure to vibration involves staff who are at an elevated ('particular') risk of suffering HAVS. As well as considering such staff in risk assessments, occupational health screening should seek to identify such persons and individual risk assessment undertaken on their exposure to vibration as necessary. It is generally considered that exposure to a vibration level of 1 m/s^2 or less will not cause any adverse symptoms.

3.11 Where the EAV is likely to exceeded or there are items of high risk equipment present, ie those whose use could exceed the ELV within 30 minutes of use and have a vibration magnitude of 10 m/s^2 or greater, health surveillance for their users should be provided. This is to help identify if they are showing any symptoms of HAVS (see sections 3.23 - 3.27 for more details about health surveillance).

3.12 Vibration data for all proposed purchases of new hand held tools, hand fed machinery and ride on equipment should be obtained from the manufacturer / supplier. The likely levels of exposure must be taken into account when selecting new equipment for purchase. Where possible, equipment with lower levels of vibration should be selected.

Whole Body Vibration

3.13 Driving off road or operating a ride-on vehicle under extreme conditions can give rise to WBV. There is likely to be a risk of elevated levels of WBV if one or more of the following occur (although it should be noted that it is estimated that less than 1% of the persons exposed to WBV at work are likely to exceed the ELV):

- Regular off road driving for long periods ie for several hours or more per working day
- Driver is jolted, shaken or lurches from side to side or backwards and forwards during vehicular movement
- Severe shocks or jolts are transmitted into the operator's seat
- The vehicle has no suspension or has solid tyres
- The manufacturer or supplier of the vehicle warns of WBV risks
- Vehicles are used for work or on rough terrain they were not designed for
- There is wear, tear and breakages on the vehicle that may be due to high levels of vibration or shock
- Vehicles have damaged seats or seat suspension mechanisms
- Replacement suspension seats are unsuitable for the vehicle

- Vehicles regularly use poorly surfaced or potholed roads for a considerable proportion of their daily use
- There is a history of back pain in the job
- Reports of uncomfortable levels of vibration are received
- Reports of lower back pain during or after exposure to WBV

3.14 If it is considered these off road driving risk factors, or other operations such as work in helicopters or riding in high speed boats in rough conditions, are part of the work and may give rise to high levels of WBV, then the following steps should be taken and an initial assessment undertaken to determine if further action is warranted:

- Obtain data as to the likely magnitude of WBV vibration from the high risk operations or equipment, either from the tests done at commissioning, from the manufacturer, from results obtained at similar activities either within or outside NERC or by direct measurement of actual exposure during working conditions
- Identify the duration of exposure
- Calculate the likely daily levels of exposure of staff to WBV
- If it is considered the WBV EAV is unlikely to be exceeded, record this conclusion and inform users of the conclusion there is no risk, providing any information which supports or ensures this

3.15 Where there is a possibility the relevant EAV will be exceeded, a written risk assessment should be undertaken. This should identify risk reduction procedures to eliminate exposure at source or reduce exposure to as low a level as is reasonably practicable and ensure the ELV is not exceeded. One example could be by use of special anti-vibration seating. Guidance on writing a WBV risk assessment is given at Appendix 4.

3.16 Where there are significant and severe jolts or shocks involved, such as when driving over potholes or rocks, the standard average measure of WBV in terms of m/s^2 A(8) may not give a sufficient representation of the true risk. If such severe shocks are possible, observation of the task should give a subjective indication and an alternative measure of vibration may be used, such as the Vibration Dose Value (VDV). VDV levels of 17 $m/s^{1.75}$ are considered very high and should be avoided.

3.17 Individuals whose health is at elevated ('particular') risk from WBV should be identified and, where necessary, specific risk assessments for those staff produced. Appendix 4 gives more detail.

3.18 Where the WBV EAV may be exceeded, there are staff at elevated risk who do work with equipment that may pose a WBV risk or there is high risk equipment or machinery, health surveillance should be provided for those individuals at risk (see sections 3.23 – 3.27 for more details about health surveillance).

3.19 All purchases of new ships, high-speed boats, planes and powered ride-on machinery / transport should involve consideration of WBV exposure and take this into account when selecting what is bought.

3.20 Measurements taken so far aboard NERC ships suggest hazardous levels of whole body vibration is extremely unlikely to be reached, with the worst level recorded being 0.322 m/s^2 within an engine room, which would allow over 19 hours occupancy before the EAV was exceeded.

3.21 Any significant conclusions of the risk assessments must be recorded and the measures and actions to eliminate or reduce and adequately control the risk of injury from vibration implemented, so far as is reasonably practicable. If it is considered the levels of exposure of workers to vibration are very unlikely to approach the EAV no further action is strictly required. However, it will be necessary to record and retain details of the basis of how this conclusion was reached eg that the exposure to vibration created by the equipment or activity will be far below the EAV given the magnitude of vibration and the maximum duration of the activity. If necessary, the grounds for reaching this conclusion should be explained to the staff involved.

3.22 For older items of equipment which generate high levels vibration and have significant duration of use, a programme of replacement or disposal should be considered.

Health Surveillance

3.23 Health surveillance is a programme of systematic health checks to identify early signs and symptoms and to allow action to be taken to prevent its progression. It is also useful in monitoring the effectiveness of controls.

3.24 If the risk assessment indicates there are individuals who are at particular risk to health from vibration or employees who are, or are liable to be, exposed to vibration at or above the EAV then suitable health surveillance for those employees must be provided. Staff who may be considered to be particularly sensitive to vibration include those with existing HAVS or other diseases of the hands, arms, wrists or shoulders or with diseases affecting blood circulation such as diabetes or nerve disorders affecting the hands or arms such as carpal tunnel syndrome.

3.25 The health surveillance shall be appropriate ie where a link can be established between the vibration exposure and an identifiable disease / adverse health effect and it is probable the disease may occur under the particular conditions of work and there are valid techniques for identifying the disease or effect.

3.26 Where employees undergo health surveillance for vibration a health record must be maintained and kept available, which the employee may access following reasonable notice and be provided to the HSE if required.

3.27 If an identifiable disease or condition is considered by a doctor or other occupational health practitioner to be as a result to exposure to vibration, then the individual must be informed by a suitably qualified person and information and advice provided regarding further health surveillance. Also, the employer must:

- Ensure he is informed about any significant findings arising from the health surveillance
- Review the vibration risk assessment
- Review the measures in place to eliminate or control exposure to vibration, taking into account the occupational health advice
- Consider re-assigning the employee to alternative work with no risk of exposure to vibration, taking into account the occupational health advice
- Review the health of other employees who have been similarly exposed, including a medical examination if recommended.

Information, Instruction and Training

3.28 If there is considered to be a risk to the health of employees from exposure to vibration at work or the exposure is likely to be at or above the EAV then suitable information, instruction and training should be provided for those employees.

3.29 This should enable the employees to fully understand the level of risk they may be exposed to, how it is caused and the possible health effects. The information, instruction and training should include consideration of:

- Which work equipment and processes cause vibration and their respective levels of risk
- How their personal daily exposures compare to the EAV and ELV
- Symptoms they should look for and action they should take if they believe they have those symptoms
- Control measures that are introduced to reduce risks
- Use of PPE where it is required by the risk assessment eg the need to keep warm
- Training necessary to control exposure eg selection, use, maintenance of equipment and restriction of duration of exposure
- Any health surveillance required and why it is important
- The individual's duty in following the conclusions of the risk assessment and any safe systems of work intended to reduce exposure to vibration, reporting any defects or problems with equipment eg unusually high vibration levels and co-operating with the programme of control measures and health surveillance.

4. REFERENCES / REGULATIONS / GUIDELINES

1. The Control of Vibration at Work Regulations 2005 http://www.legislation.gov.uk/uksi/2005/1093/contents/made
2. ISO 5349-1:2001: 'Mechanical Vibrations, Measurement and Assessment of Hand-Arm Vibration Exposure', International Standards Organisation, Geneva
3. 'Hand Arm Vibration: The Control of Vibration at Work Regulations 2005', Guidance on Regulations, L140, HSE ISBN 0-7176-6125-1 (downloadable from HSE website)
4. 'Whole Body Vibration: The Control of Vibration at Work Regulations 2005', Guidance on Regulations, L141, HSE ISBN 0-7176-6126-1 (downloadable from HSE website)
5. Industrial Noise and Vibration Centre Ltd, Hand Arm and Whole Body Vibration Briefing to NERC from Peter Wilson, October 2009 (copy available internally to NERC safety staff)

5. ROLES / RESPONSIBILITIES

Director is responsible for:

- Implementing a procedure to cover vibration risks which meets or extends NERC minimum standards as laid out in this procedure

Managers are responsible for:

- Identifying equipment for which special vibration precautions are required

- Ensuring that vibration levels are taken into account when purchasing or hiring new equipment and that data on vibration magnitude is obtained for all new equipment purchased or hired
- Ensuring that vibration risk assessments are undertaken by competent persons as necessary
- Signing off vibration risk assessments and ensuring that they are reviewed
- Ensuring staff are aware of the local vibration procedures and that safe systems of work and the precautions specified in vibration risk assessments are followed
- Identifying members of their staff who need health surveillance
- Identifying the training needs of staff on vibration
- Ensuring that reports of ill health from vibration are investigated and suitable action taken

Vibration Risk Assessors are responsible for:

- Ensuring that data on hand arm and whole body vibration from relevant equipment and activities has been obtained, including magnitude of vibration and duration of exposure ('trigger time')
- Observing the work, the conditions of the workplace under which it is undertaken and the methods used
- Ensuring that a suitable and sufficient risk assessment for vibration risks is carried out

Person(s) responsible for maintaining equipment are responsible for:

- Ensuring suitable maintenance regime is in place for equipment that presents a vibration risk
- Ensuring tools and equipment maintenance regimes are followed and that aspects which reduce vibration are regularly checked as necessary eg sharpness of cutting tools, condition of tool mounting devices.

Safety Advisors are responsible for;

- Ensuring systems are in place which identify activities with a high risk of vibration injury where the EAV may be reached
- Keeping records of injuries, incidents and investigations
- Auditing
- Information, instruction and training on HAV and WBV is provided where necessary
- In conjunction with Human Resources, that suitable provisions for identifying staff at increased ('particular') risk from vibration are in place and that health surveillance is available where necessary.

Users of equipment that poses a vibration risk are responsible for:

- Reporting any symptoms of vibration injury at an early stage and informing management of any any medical or physical conditions which may give rise to an increased risk of developing vibration injury
- Attending any information, instruction or training sessions on vibration hazards as requested
- Ensuring they are aware of any restrictions on duration of use or other safety precautions that may apply to use of equipment with a vibration risk

- Being aware of and following the precautions in, any risk assessment in place for the equipment
- Cooperating in producing risk assessments and implementing risk management systems for vibration
- Using equipment that is 'fit for purpose', in the appropriate manner and changing bits, blades etc as required in order to minimise vibration and effort
- Reporting any defects in the equipment eg higher than normal vibration levels
- Reporting any accidents, incidents or near misses to the local reporting system
- Using and wearing PPE in the correct manner as required in the risk assessment, replacing it and reporting any damage or wear as required
- Observing and following any 'traffic light' systems in place

6. ATTACHMENTS / APPENDICES

1. Appendix 1: General Background to Hand arm vibration
2. Appendix 2: General background to Whole Body Vibration
3. Appendix 3: Risk Assessment and Measures to Eliminate / Minimise Hand Arm Vibration risk
4. Appendix 4: Risk Assessment and Measures to Eliminate / Minimise Whole Body Vibration risk
5. Appendix 5: Vibration Magnitude, Measuring and Calculating Exposures
6. Appendix 6: Traffic light system of Managing HAV from hand held / hand guided equipment

Appendix 1: General Background to Hand Arm Vibration

Exposure to high levels of hand and arm vibration damages blood vessels, reducing blood supply, damages nerves causing permanent loss of feeling and it may also bones and muscles leading to conditions like arthritis.

Vibration White Finger (VWF) is the most common symptom of Hand Arm Vibration Syndrome (HAVS) and is usually first set off by cold. Symptoms are:

- occasional attacks when fingertips turn white with affected areas increasing in size if exposure to vibration continues
- numbness
- "pins and needles",
- "chilblains" at the end of an attack - returning circulation (red flush) can be very painful
- manual dexterity and grip strength reduced
- vibration related carpal tunnel syndrome

Continued exposure to high levels of hand arm vibration can lead to some or all of the following:

- extensive blanching of most fingers, even in summer
- finger pain, swelling, ulcerations
- continuous numbness - continuous aching (up to the elbow)
- severely reduced sense of touch
- seriously reduced manual dexterity and grip strength

- sufferers can't dress themselves easily, carry out car maintenance, gardening etc, and some may have distorted finger joints.

The number of people who suffer is considered to be considerably under reported. HSE research prior to the implementation of the CoVaWR indicated that about 5 million people are at risk (20% of working age men, 3% of working age women). Approximately 2million people are exposed to levels of vibration where they are clear risks of developing disease. HSE estimated c 770 000 people suffer from finger blanching attributable to HAV exposure with 43% of cases in mining, 28% in shipbuilding and repair, 10% in construction and 19% in other industries. Claims for civil damages are running at 8000 - 9000 cases per year and the HSE estimates that VWF claims now represent 9% of all employers' liability cases. There are 40,000 ex-miners' claims.

Items which potentially expose users to a high level of hand arm vibration include:

- percussive tools such as breakers, drills, fettling, hammers
- grinding / finishing equipment such as angle grinders, linishing, polishing, de- burring, sanding machines
- woodworking / gardening equipment such as strimmers, motor mowers, chain saws and circular saws
- others: concrete pokers, coil taping machines, drain suction machines, shoe pounding, motorbikes, quadbikes and skidoos

Appendix 2: General background to Whole Body Vibration

Whole Body Vibration (WBV) is concerned with cases where the human body is subject to vibration via:

- feet (standing personnel)
- buttocks, back and seat (seated personnel)
- supporting surface (recumbent personnel)

The measurement of WBV may sometimes require specialised facilities e.g. artificial "seat". It should be noted the CoVaWR only apply to a seated or standing person, not to a recumbent person.

Drivers of transport are potentially exposed to WBV and will often suffer backache. However, WBV, especially jolts and shocks, is only one cause of backache. Other causes are:

- poor design/adjustment of seating or controls
- poor driver posture
- long periods in seat
- manual handling
- awkward access/jumping down from cab
- non-occupational causes

This provides the hierarchy for investigation - only assess WBV after the other possible issues have been addressed

Numbers of People Affected:

- 9,000,000 exposed to WBV are mainly employed in road transport, but this is still a low risk
- Approx 1,300,000 may be above the EAV but most are still low risk
- About 20,000 may be exposed above the ELV eg in agriculture, mining, quarrying, construction, etc

The effects of direct vibration on the body can be serious. High levels of periodic, random or transient vibration can cause the following:

- degraded health
- impaired activity
- impaired comfort
- motion sickness

The long term effects on health can include permanent damage to:

- internal organs
- lower back (lumbar spine)
- digestive system
- reproductive organs

However, the WBV EAV and ELV in the regulations are not based on good scientific evidence and it is highly likely that there will be or no significant risk to health at these levels of vibration.

WBV can be caused by:

- the movement of the wheels or tracks of a vehicle or mobile machine crossing an uneven surface
- while using mobile machines to excavate holes or trenches in the ground or to load materials such as sand or gravel into lorries
- the rotation of the rotor blades of a helicopter which may cause quite high levels of WBV transmitted through the airframe into the seats
- fast boats travelling across rough seas
- railway vehicles
- operating large static compaction, hammering or punching machines, such as hammer mills and mobile crushers.
- ship vibration - including structural resonances

Appendix 3: Risk Assessment and Measures to Eliminate / Minimise Hand Arm Vibration Risk

The risk assessment of daily exposure to HAV should be by means of:

- Observing specific working practices
- Obtaining relevant information on the probable magnitude of vibration from the equipment used in particular working conditions
- If necessary (and this should only be required in exceptional cases where it is not possible to obtain relevant data by other means) measuring the magnitude

  of vibration to which employees are liable to be exposed. It is possible also use data on specific items of equipment provided by manufacturer or derived by reputable test house under typical conditions of use but

care is required in interpreting data it. The ‘best case’ manufacturer’s data should not just be taken as representative of true real life exposure. If necessary, where it is not considered the data obtained is not truly representative and may only be a best case, a multiplier of x2 should be applied when assessing the likely exposure.

The risk assessment should consider all factors related to risk including:

- The practicability of preventing exposure,
- The steps needed to achieve / maintain adequate control where prevention is not reasonably practicable,
- The need for health surveillance
- How / when to put the steps decided upon into action.

The risk assessment may be considered ‘suitable and sufficient’ if it identifies:

- Where it considers there may be a risk (if there is considered to be no risk this must also be recorded along with the reason why and any data used to reach this conclusion eg the vibration levels and duration of exposure)
- A soundly based estimate of exposures and comparison with the ELV and EAV
- The available risk controls
- Identifies those individuals who may be more at risk (’high risk’ groups include those with existing HAV or other diseases of the hands, arms, wrists and shoulders or those with diseases affecting blood circulation)
- Steps to control and monitor risks
- Records the date of the assessment, who undertook it and what activities / areas / equipment it covers
- A Review date
- An approval signature from a responsible person

The risk assessment should take into account:

- Magnitude, type and duration of exposure – the greater the magnitude the shorter the allowable duration may need to be
- Effects of vibration on ‘at risk’ employees

- Effects of vibration on equipment and workplace, including handling of controls, reading of indicators stability of structures and security of joints
- Information provided by manufacturer
- Availability of replacement equipment which poses lower risk from vibration
- Specific working conditions such as temperature
- The precautions to protect those who are at a particular (elevated or high risk
- Information from health surveillance including, where possible, published information

Under the CoVaWR, the measures to eliminate or adequately control of exposure to vibration which implements the hierarchy of controls principles are, in descending order:

- Use working methods which eliminate or reduce exposure to vibration (replace hand operated vibrating roller with a remote controlled version)
- Select work equipment of appropriate ergonomic design (newer, better designed machinery often emits significantly lower levels of vibration than traditional types)
- Provide auxiliary equipment (use balanced grinding wheels)
- Appropriate maintenance programmes (worn parts or loose components will significantly increase vibration levels, also encourage employees to report unusually high vibration levels)
- Design and layout of workplaces (use balancers to help support equipment so it does have to be held so tightly)
- Suitable and sufficient information and training for employees
- Limitation of the duration and magnitude of exposure (this is the final resort when other precautions to eliminate or reduce exposure have been implemented)
- Appropriate work schedules with adequate rest periods (frequent breaks are better practice than long uninterrupted vibration exposures even though evidence to support this is incomplete)
- Protect employees from cold and damp (keeping employees warn and dry, either by maintaining good working environment or by providing and using PPE will help maintain good blood circulation and reduce likelihood of vascular symptoms such as finger blanching)
- Ensure exposure not above exposure limit value (the ELV is an absolute maximum which under no circumstances should be exceeded)
- Exposure average over one week (see section 3.8 as this can only be used under exceptional circumstances)
- Employees likely to be particularly at risk (see section 3.9.2)

Note: Schedule 3 of RIDDOR makes HAVS (occupational disease no. 14) reportable where it involves the following activities:

- *Use of chain saws, brush cutters or hand-held or hand fed circular saws in forestry or woodworking*
- *Use of hand-held rotary tools in grinding material or in sanding or polishing metal*
- *The holding of material being ground or metal being sanded or polished by rotary tools*
- *The use of hand-held percussive metalworking tools or the holding of metal being worked on by percussive tools in connection with riveting, caulking, chipping, hammering, fettling or swaging*
- *The use of hand-held powered percussive drills or hand-held powered percussive hammers in mining, quarrying or demolition, or on roads or footpaths (including road construction) or*
- *The holding of material being worked on by pounding machines in shoe manufacture*

Appendix 4: Risk Assessment and Measures to Eliminate / Minimise Whole Body Vibration (WBV) risk

WBV occurs when a person's body is supported on a vibrating surface, which is most likely to occur when seated in a moving vehicle or when operating vibrating machines. The main risk is from back pain which can be caused by factors independent of vibration but when the two or more factors are combined the risk can be increased. Examples will be WBV exposure for long periods without being able to change position, driving over rough ground while looking over the shoulder to check on operation or rear mounted equipment or being exposed to high levels of WBV then undertaking work involving heavy lifting.

Staff who may be at risk and need to be considered will include those who regularly drive an off road vehicle under the conditions specified in section 3.12, sit or stand on a vehicle which vibrates or shakes violently, ride in or pilot a helicopter or ride in or drive a fast boat.

Risk assessment is also necessary for people who are particularly sensitive to risks from WBV, which would include:

- Pregnant workers
- Young people bearing in mind they are at greater risk of spinal damage as muscle strength is developing and bones not fully mature until around age 25 so regular exposure to shocks and jolts should be limited
- People with neck or back problems
- People who have recently undergone any form of surgery and people with internal or external protheses (apart from dentures!)

Occupational Health professionals should be able to advise on precautions or if any working adaptations for such individuals who are at particular risk.

The risk assessment should take into account:

- Typical exposures from typical work processes using typical equipment, vehicles or machines
- Sample vibration data from the manufacturer of your equipment, vehicles or machines
- Other information on emissions and exposures and the probable magnitude of vibration from the equipment, vehicles or machines used in the particular working conditions (considering in particular the type of machine, its size / power, any anti-vibration features, the tasks the data was derived from, any equipment / attachments used, the speed of the vehicle at which the data was obtained, the ground conditions etc to help ensure it is 'typical' for the operations being assessed)
- If necessary (and this should only be required in exceptional cases where it is not possible to obtain relevant data by other means), measuring the magnitude of WBV to which employees are liable to be exposed.

The risk assessment should consider all factors related to risk including:

- The practicability of preventing exposure,
- The steps needed to achieve / maintain adequate control where prevention is not reasonably practicable,

- The need for health surveillance
- How / when to put the steps decided upon into action.

The risk assessment may be considered 'suitable and sufficient' if it identifies:

- The likelihood of the EAV being exceeded
- Gives an idea of the severity of exposure, in particular whether the ELV may be exceeded
- Equipment, machine or vehicle operations or conditions which subject the driver to large jolts and shocks
- The tasks and factors which cause most exposure
- Possible control measures, those most likely to be effective and their priority
- Identifies those individuals who may be more at risk ('high risk' groups include those with existing)
- Extension of exposure beyond normal working hours, eg exposure in rest facilities supervised by employer
- Records the date of the assessment, who undertook it and what equipment, machines, vehicles and operations it covers
- A Review date
- An approval signature from a responsible person

Controls which can be applied for exposure to WBV include:

- Information to drivers and operators on:
  - the link to back pain from exposure to WBV,
  - likely sources of hazardous WBV and risk factors such as severity of vibration and duration of exposure
  - other back pain risk factors
  - reporting back pain symptoms so that early action can be taken
  - the conclusions of any risk assessment
  - the likelihood of exposure to above the EAV or ELV
  - the control measures that need to be applied
  - the need to co-operate on minimising risks
  - any health monitoring requirements
- Training drivers to:
  - adjust driver weight settings on suspension seats where present and to avoid 'bottoming out'
  - adjust seat positions and controls to provide the best ergonomic working arrangement, including good lines of sight
  - be aware of activities, operations and conditions which create higher risk exposures
  - reduce speed as necessary to take account of ground / sea conditions and avoid excessive shocks or jolts
  - operate the equipment, machine or vehicle smoothly
  - use routes that minimise rough conditions
  - avoid potholes and bumps whilst still driving safely
  - report excessive WBV
  - report bouts of back pain
  - Use the right equipment, machine or vehicle for the job

Appendix 5: Vibration Magnitude, Measuring and Calculating Exposures for Hand Arm Vibration

The daily vibration exposure is termed the A(8) value. This is the average vibration expressed in terms of acceleration units of metres per second per second (m/s^2) measured over a standard working day of eight hours, adjusted to take account of total exposure time (ie contact time or 'trigger time'). It should be noted that the damage which results from vibration is directly proportional to exposure time (double the exposure time, double the potential damage) but is proportional to the **square** of the vibration level (double the vibration level, quadruple the potential damage). For this reason at an exposure level of 2.5 m/s^2 the EAV will be reached in 8 hours but at an exposure level of 5 m/s^2 the EAV will be reached in 2 hours.

Table1 below gives examples of typical levels of vibration from different equipment and table 2 the times to reach EAV and ELV for different levels of vibration.

Table 1 Typical levels of vibration magnitudes at various types of high risk hand arm vibration equipment

Road breakers	Typical	12 m/s^2
	Modern Tool designs, good operating conditions and trained operators	5 m/s^2
	Worst tools and operating conditions	20 m/s^2
Demolition hammers	Modern tools	8 m/s^2
	Typical	15 m/s^2
	Worst tools	25 m/s^2
Hammer drills / combi hammers	Typical	9 m/s^2
	Best tools and operating conditions	6 m/s^2
	Worst tools and operating conditions	25 m/s^2
Needle scalers	Modern tool designs	5 – 7 m/s^2
	Older tool designs	10 – 25 m/s^2
Scabblers (hammer types)	Typical	20 – 40 m/s^2
Angle grinders (large)	Typical	4 m/s^2
	Older	8 m/s^2
Angle grinders (small)	Typical	2 – 6 m/s^2
Clay spades/jigger picks	Typical	16 m/s^2
Chipping hammers (metal working, foundries)	Typical fettling	18 m/s^2
	Modern tool designs	10 m/s^2
Pneumatic stone-working hammers	Vibration reduced hammers and sleeved chisels	8 – 12 m/s^2
	Older tools, conventional chisels	30 m/s^2
Chainsaws	Typical	6 m/s^2
Brushcutters	Typical	4 m/s^2
		2 m/s^2
Sanders (random orbital)	Typical	7 – 10 m/s^2

Taken from HSE publication L140.

Table 2 Examples of times to reach the EAV and ELV for various levels of hand arm vibration

Vibration magnitude (m/s^2)	2.5	3.5	5	7	10	14	20
Time to reach Exposure Action Value (hours)	8	4	2	1	30 mins	15 mins	8 mins
Time to reach Exposure Limit Value (hours)	<24	16	8	4	2	1	>30 mins

Taken from HSE publication L140.

Where staff may be using a variety of different pieces of equipment across the working day which may have differing levels of vibration, it may be difficult to calculate the overall exposure and whether or not the EAV or ELV will have been reached or exceeded. A simple way of calculating this is to assign each hour of activity a number of exposure points, given in table 3 below according to the magnitude of vibration, which are then added together to give a total number of points accrued in the day. This total can then be used to give an aggregate daily level of exposure from a 'ready reckoner' (figure 1). 100 points equals the EAV, 400 points equals the ELV.

Table 3 Number of exposure points per hour for a range of vibration magnitudes:

Vibration (m/s^2)	3	4	5	6	7	8	9	10	12	15
Points per hour	18	32	50	72	98	130	160	200	290	450
Note: 100 points / day = Exposure Action Value, 400 points / day = Exposure Limit Value										

The figure below is the HSE 'ready reckoner' where the total number of points accrued in the day can be read off to give an average daily exposure:

Fig. 1 'Ready Reckoner' linking Exposure Points to overall daily exposure

Key

An alternative way to using exposure points, which links varying levels of exposure from different equipment and their duration of use in a single working day, is to use 'partial exposures'. The partial exposure from each activity are added together to give an average daily exposure level or A(8). The nomogram below at Figure 2 allows both partial exposures and exposure points to be determined.

Fig.2 Nomogram of Vibration Magnitude ('weighted acceleration') v Daily

Exposure Time for HAV to give A(S) Partial Exposures or Exposure Points

Appendix 6: Traffic light system of managing HAV from hand held / hand guided equipment

Where the work is unlikely to involve using more than one item of equipment posing a risk of HAV during the working day, which is considered to be the case for much work within NERC, a simplified system of informing staff and helping prevent exposure above the EAV can be used. This is a 'traffic light' system which involves attaching a suitable colour coded indicator or tag to each item of equipment to give any trained operator using that equipment an immediate indication of the maximum time for which each item may be used in a working day before the EAV is reached. If a variation of the working period is required which would take its duration above the maximum specified, then a specific risk assessment would be required. The aim is to keep exposure to below the EAV and to avoid the need for a risk assessment but variations which refer to a generic risk assessment are possible. This system has problems where the work involves using more than one higher risk (amber or red) item in a single working day and in such circumstances the points system or nomogram method should be used to ensure exposure is kept to acceptable levels. Some versions of the traffic light system (as used by some hire companies) are only designed to prevent exposure above the ELV so following them does not avoid the requirement for a risk assessment. This means that care may be required in interpreting and applying traffic light codes for hired equipment.

One version that could be used is:

Low risk - Green = equipment with a vibration magnitude of 0 to less than 2.5 m/s^2 – tools can be used forup to 8 hours per day, no risk assessment required.

Medium risk - Amber = equipment with a vibration magnitude of 2.5 to less than 5 m/s^2 – max 2 hours use per day unless specific risk assessment in place.

High risk - Red = equipment with a vibration magnitude of 5 m/s^2 or greater - specific risk assessment must be in place.

This version does not capture operations of short duration (less than 30 mins) at equipment with a vibration magnitude between 5 m/s^2 to less than 10 m/s^2. If desired, this could be covered by creating an additional medium risk traffic light band of 5 m/s^2 to less than10 m/s^2 with less than 30 mins exposure and making the red band for equipment with vibration levels of 10 or more m/s^2.