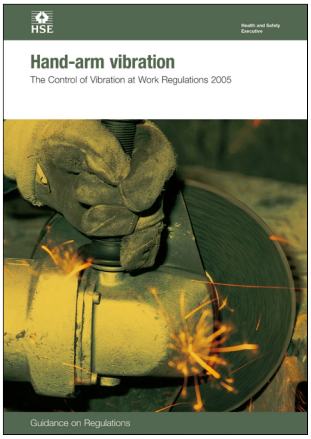
Hand-arm vibration

The Control of Vibration at Work Regulations 2005

Guidance on Regulations



L140 (Second edition)
Published 2019

Hand-arm vibration or HAV is a widespread hazard for employees in many industries and occupations. This second edition of L140 outlines what an employer's duties are under the Control of Vibration at Work Regulations 2005 as they relate specifically to HAV (HSE publication L141 deals with whole-body vibration).

The book looks at the employer's legal obligations to control risks to employees' health and safety from exposure to HAV and to prevent HAV-related diseases such as hand-arm vibration syndrome and carpal tunnel syndrome. It covers the management and control of the risks from HAV and how to protect employees, with practical guidance on risk assessments, controlling vibration exposure and arranging health surveillance.

The guidance is aimed at employers as well as those who advise employers, such as health and safety professionals, vibration specialists and occupational health professionals.





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This guidance is issued by the Health and Safety Executive. Following the guidance is not compulsory, unless specifically stated, and you are free to take other action. But if you do follow the guidance you will normally be doing enough to comply with the law. Health and safety inspectors seek to secure compliance with the law and may refer to this guidance.

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Introduction

1 Hand-arm vibration (HAV) is a widespread hazard for employees in many industries and occupations, eg energy, extraction, manufacturing and construction. HAV exposure at work can arise from the use of handheld machines (such as grinders and hammer drills), hand-guided machinery (such as lawnmowers and plate compactors) and hand-fed machines (such as pedestal grinders and forge hammers). Regular and frequent exposure to this vibration, usually over many months or years, can affect the operator's health. But the risks from vibration can be controlled and most employees can be protected from ill health caused by vibration. To protect employees, and to comply with the Control of Vibration at Work Regulations 2005 (the Vibration Regulations), employers need to assess the risks from vibration and implement measures to control them.

2 This book is aimed at employers, but is expected to be of particular interest to those advising employers on the Vibration Regulations as they relate to HAV, including competent person(s), health and safety professionals, vibration specialists and occupational health professionals. It does not contain guidance on those parts of the Regulations which apply only to whole-body vibration as this is provided in a separate book, *Whole-body vibration. The Control of Vibration at Work Regulations 2005*.[1] The parts of the Vibration Regulations which apply specifically to whole-body vibration are identified by grey shading.

3 The Vibration Regulations place specific duties on employers and are based on a European Union Directive[2] requiring similar basic laws throughout the EU on reducing the risks of vibration-related diseases. If employers comply with the Vibration Regulations and follow HSE's guidance, employees are unlikely to develop advanced (disabling) stages of these diseases.

4 This book sets out the legal, technical and medical principles. The legal duties described in this book are in addition to the general obligations to safeguard workers' health (including the effects of vibration) which employers and others (including advisers to employers) have had since 1975 under the Health and Safety at Work etc Act 1974 (the HSW Act).[3] These general obligations also apply to the safeguarding of the health of people who are not employees, such as students, voluntary workers, visitors and members of the public. Employees also have duties under the HSW Act to take care of their own health and safety and that of others whom their work may affect; and to co-operate with employers so that they may comply with health and safety law.

Part 1 Legal duties of employers and others to control the risks to health and safety from hand-arm vibration

5 Part 1 of this book includes the text of the Vibration Regulations and explains what they mean and what they require you to do. It sets out your legal obligations as an employer to control risks to health and safety from exposure to HAV, including preventing HAV-related diseases which affect the hands and arms, and

providing health surveillance for the conditions known as hand-arm vibration syndrome (HAVS) and vibration-related carpal tunnel syndrome (v-CTS).

Part 2 Management and control of risk from hand-arm vibration

6 Part 2 of the book includes practical information for employers managing vibration risk: assessing exposure and risk; deciding how the Regulations apply; and planning and applying control of risk. It is supplemented by Appendices 1–7.

Part 3 Health surveillance

7 Part 3 of the book provides practical information on what would be expected from a health surveillance programme. Appendices 8–9 provide supplementary technical and medical guidance for occupational health professionals and health and safety professionals. They should read Part 3 and will find it helpful to familiarise themselves with Parts 1 and 2 so that they have a good understanding of what the employer has to do and what help they need.

Reasons for this revision

8 This guidance has been updated in keeping with changes to related legislation, technical advances and experience. The layout of this revision has been modified to emphasise control of exposure. There are minor changes to the legislation but no changes to HSE's policy on the control of HAV.

9 A revised Machinery Directive 2006/42/EC came into force across Europe on 29 December 2009, implemented in the UK as the Supply of Machinery (Safety) Regulations (SMR) 2008.[4,5,6] Harmonised standards supplementing and elaborating on the requirements of this Directive have improved the information about vibration being supplied with powered hand tools.

10 The guidance in this book will continue to help dutyholders to reduce risks from vibration to the lowest level reasonably practicable. Further information is available on the vibration pages of HSE's website: www.hse.gov.uk/vibration.

11 HSE has also produced a leaflet for employers, *Hand-arm vibration at work: A brief guide*,[7] which includes a brief introduction to the Vibration Regulations and provides the essential information that you will need to comply with them. *Hand-arm vibration: A guide for employees*[8] is a pocket card that contains straightforward advice for employees.

PART 1 Legal duties of employers and others to control the risks to health and safety from hand-arm vibration

Regulation 1 Citation and commencement

Regulation 1

These Regulations may be cited as the Control of Vibration at Work Regulations 2005 and shall come into force on 6th July 2005.

Regulation 2 Interpretation

Regulation 2

(1) In these Regulations –

"daily exposure" means the quantity of mechanical vibration to which a worker is exposed during a working day, normalised to an 8-hour reference period, which takes account of the magnitude and duration of the vibration;

"emergency services" include –

- *(a) police, fire, rescue and ambulance services;*
- *(b) Her Majesty's Coastguard;*

"enforcing authority" means the Executive, the Office for Nuclear Regulation, local authority or Office of Rail and Road determined in accordance with —

- *(a) section 18(1A) of the Health and Safety at Work etc. Act 1974;*
- *(b) the provisions of the Health and Safety (Enforcing Authority) Regulations 1998;*
  and
- *(c) the provisions of the Health and Safety (Enforcing Authority for Railways and Other Guided Transport Systems) Regulations 2006;*

"exposure action value" means the level of daily exposure set out in regulation 4 for any worker which, if reached or exceeded, requires specified action to be taken to reduce risk;

"exposure limit value" means the level of daily exposure set out in regulation 4 for any worker which must not be exceeded, save as set out in regulation 6(5);

"the Executive" means the Health and Safety Executive;

"hand-arm vibration" means mechanical vibration which is transmitted into the hands and arms during a work activity;

"health surveillance" means assessment of the state of health of an employee, as related to exposure to vibration;

"mechanical vibration" means vibration occurring in a piece of machinery or equipment or in a vehicle as a result of its operation;

Regulation 2

"risk assessment" means the assessment of risk required by regulation 5;

"whole-body vibration" means mechanical vibration which is transmitted into the body, when seated or standing, through the supporting surface, during a work activity or as described in regulation 5(3)(f); and

"working day" means a daily working period, irrespective of the time of day when it begins or ends, and of whether it begins or ends on the same calendar day.

(2) In these Regulations, a reference to an employee being exposed to vibration is a reference to the exposure of that employee to mechanical vibration arising out of or in connection with his work.

Regulation 3 Application and transitional provisions

Regulation 3

(1) These Regulations shall have effect with a view to protecting persons against risk to their health and safety arising from exposure to vibration at work.

(2) Subject to paragraph (3), regulation 6(4) shall not apply until 6th July 2010 where work equipment is used which –

- *(a) was first provided to employees prior to 6th July 2007 by any employer; and*
- *(b) does not permit compliance with the exposure limit values,*

but in using such equipment the employer shall take into account the latest technical advances and the organisational measures taken in accordance with regulation 6(2).

(3) For the agriculture and forestry sectors, regulation 6(4) shall not apply to whole-body vibration until 6th July 2014 in respect of work equipment which –

- *(a) was first provided to employees prior to 6th July 2007 by any employer; and*
- *(b) does not permit compliance with the exposure limit value for whole-body vibration,*

but in using such equipment the employer shall take into account the latest technical advances and the organisational measures taken in accordance with regulation 6(2).

(4) Where a duty is placed by these Regulations on an employer in respect of his employees, he shall, so far as is reasonably practicable, be under a like duty in respect of any other person, whether at work or not, who may be affected by the work carried out by the employer except that the duties of the employer –

- *(a) under regulation 7 (health surveillance) shall not extend to persons who are not his employees; and*
- *(b) under regulation 8 (information, instruction and training) shall not extend to persons who are not his employees, unless those persons are on the premises where the work is being carried out.*

(5) These Regulations shall apply to a relevant self-employed person as they apply to an employer and an employee and as if that relevant self-employed person were both an employer and an employee, except that regulation 7 shall not apply to a relevant self-employed person.

Regulation 3

(5A) For the purposes of this regulation, "relevant self-employed person" means a self-employed person who conducts an undertaking of a prescribed description for the purposes of section 3(2) of the Health and Safety at Work etc. Act 1974.

(6) These Regulations shall not apply to the master or crew of a ship or to the employer of such persons in respect of the normal shipboard activities of a ship's crew which are carried out solely by the crew under the direction of the master, and for the purposes of this paragraph "ship" includes every description of vessel used in navigation, other than a ship forming part of Her Majesty's Navy.

Guidance 3

Transitional period

12 Regulation 3(2) refers to the transitional period for the exposure limit value which applied only until 6 July 2010. The transitional period has now passed.

People who are not your employees

13 Sometimes your activities may cause people who you do not directly employ to be exposed to vibration; for example, where sub-contractors use vibrating equipment for work you specify and control, or where volunteers are engaged alongside workers. Regulation 3(4) applies to all the employers involved and each will have a responsibility:

(a) to their own employees;
(b) so far as is reasonably practicable, to anyone else who is exposed to vibration in work activities under their control.

14 This responsibility applies to all the duties under these Regulations except health surveillance (regulation 7) for anyone other than their own employees, while information, instruction and training (regulation 8) shall not extend to persons who are not his employees, unless those persons are on the premises where the work is being carried out.

15 Employers must exchange information and collaborate when working on joint projects to ensure they fulfil their duties without confusion or unnecessary duplication. On multi-contractor sites they will need to co-ordinate action to comply with health and safety requirements; this will normally be the person in overall control of the work. Where contractors and subcontractors are involved it is usually best for responsibilities to be set out in the contractual arrangements. For construction projects, the principal contractor under the Construction (Design and Management) Regulations 2015[9] should ensure co-operation between all contractors through the use of pre-tender health and safety plans, method statements etc.

The relevant self-employed

16 Regulation 3(5) defines both employer and employee to include relevant self-employed people. So if you are a relevant self-employed person you will need to take action as set out in the Vibration Regulations to protect yourself from vibration risks.

Guidance 3

Trainees

17 The Health and Safety (Training for Employment) Regulations 1990[10] require trainees on relevant work training schemes in the workplace (but not those on courses at educational establishments such as universities or schools) to be treated as the employee of the person whose undertaking is providing the training. Your duties towards trainees will include all the requirements of these Vibration Regulations, including assessment and control of risks, provision of health surveillance and provision of information and training.

Application to ships, other vessels and aircraft

18 The Vibration Regulations apply to work taking place in ships, boats, and other vessels operated by Her Majesty's Navy at all times. They also apply to work on any vessel carried out alongside shore workers when it is moored or in dock. Regulation 3(6) states that these Regulations do not apply to the master and crew of a ship. This refers to work done by the crew under the control of the ship's master when the ship is under way or work done by them in harbour when no shore-based workers are involved. The Maritime and Coastguard Agency has introduced the Merchant Shipping and Fishing Vessels (Control of Vibration at Work) Regulations 2007,[11] which apply to vessels in UK waters and to UK-registered vessels in international waters.

19 The Vibration Regulations apply to aircraft in flight over British soil. However, the Regulations are not intended to interfere with the flight safety of aircraft. Any proposals to alter an aircraft to comply with the Regulations should be agreed with the Civil Aviation Authority (CAA).

Regulation 4 Exposure limit values and action values

Regulation 4

(1) For hand-arm vibration –

(a) the daily exposure limit value is 5 m/s^2 A(8);
(b) the daily exposure action value is 2.5 m/s^2 A(8),

and daily exposure shall be ascertained on the basis set out in Schedule 1 Part I.

(2) For whole-body vibration –

(a) the daily exposure limit value is 1.15 m/s^2 A(8);
(b) the daily exposure action value is 0.5 m/s^2 A(8),

and daily exposure shall be ascertained on the basis set out in Schedule 2 Part I.

Guidance 4

20 The daily exposure limit value (ELV) is the maximum amount of vibration an employee may be exposed to on any single day (see regulation 6(4)). The daily exposure action value (EAV) is the level of daily exposure to vibration at or above which you are required to take certain actions to reduce exposure (see regulations 6(2), 7(1)(b) and 8(1)(b)).

21 Guidance on how to estimate employees' daily exposure for comparison with the ELV and EAV is given in Part 2.

Regulation 5 Assessment of the risk to health created by vibration at the workplace

Regulation 5

(1) An employer who carries out work which is liable to expose any of his employees to risk from vibration shall make a suitable and sufficient assessment of the risk created by that work to the health and safety of those employees and the risk assessment shall identify the measures that need to be taken to meet the requirements of these Regulations.

(2) In conducting the risk assessment, the employer shall assess daily exposure to vibration by means of –

- *(a) observation of specific working practices;*
- *(b) reference to relevant information on the probable magnitude of the vibration corresponding to the equipment used in the particular working conditions; and*
- *(c) if necessary, measurement of the magnitude of vibration to which his employees are liable to be exposed,*

and the employer shall assess whether any employees are likely to be exposed to vibration at or above an exposure action value or above an exposure limit value.

(3) The risk assessment shall include consideration of –

- *(a) the magnitude, type and duration of exposure, including any exposure to intermittent vibration or repeated shocks;*
- *(b) the effects of exposure to vibration on employees whose health is at particular risk from such exposure;*
- *(c) any effects of vibration on the workplace and work equipment, including the proper handling of controls, the reading of indicators, the stability of structures and the security of joints;*
- *(d) any information provided by the manufacturers of work equipment;*
- *(e) the availability of replacement equipment designed to reduce exposure to vibration;*
- *(f) any extension of exposure at the workplace to whole-body vibration beyond normal working hours, including exposure in rest facilities supervised by the employer;*
- *(g) specific working conditions such as low temperatures; and*
- *(h) appropriate information obtained from health surveillance including, where possible, published information.*

(4) The risk assessment shall be reviewed regularly, and forthwith if –

- *(a) there is reason to suspect that the risk assessment is no longer valid; or*
- *(b) there has been a significant change in the work to which the assessment relates,*

and where, as a result of the review, changes to the risk assessment are required, those changes shall be made.

(5) The employer shall record –

- *(a) the significant findings of the risk assessment as soon as is practicable after the risk assessment is made or changed; and*
- *(b) the measures which he has taken and which he intends to take to meet the requirements of regulations 6 and 8.*

Guidance 5

Risk assessment

22 Risk assessment is about identifying sensible and proportionate measures to control the risks in your workplace, not about creating huge amounts of paperwork. You are probably already taking steps to protect your employees, but your risk assessment will help you decide whether you should be doing more, such as:

(a) the practicability of preventing exposure;
(b) the steps which need to be taken to achieve and maintain adequate control of exposure where elimination is not reasonably practicable;
(c) how and when to put the steps you have decided on into action;
(d) the need for health surveillance

23 See Part 2 for more detailed guidance on risk assessment. Paragraphs 24–47 explain the meaning of the various terms used in regulation 5 and their effects on the risk assessment.

Guidance 5(1)

'A suitable and sufficient assessment'

24 An assessment will be suitable and sufficient if it identifies:

(a) where there may be a risk from HAV;
(b) a soundly based estimate of your employees' exposures and a comparison with the EAV and ELV;
(c) the available risk controls;
(d) the identification of those individuals who may be more at risk;
(e) the steps you have already taken, or you plan to take, to control and monitor those risks.

25 Your exposure estimate will only be soundly based if it uses data which can be judged to be reasonably representative of your work process. In most cases where the assessment evidence suggests that exposure is unlikely to exceed the EAV, it is sufficient to record that fact, though you are still required to reduce risk to as low as reasonably practicable (ALARP). Some employees, eg those with existing health problems, may be at risk from exposures below the EAV and need to be protected by additional control measures. If exposure is likely to be above the EAV, a more systematic assessment will be required.

'The measures that need to be taken to meet the requirements of these Regulations'

26 When you have identified the work processes which expose your employees to vibration you must decide what can be done to eliminate or reduce the risks, and when to take action. If the EAV is likely to be exceeded you must establish a programme of risk-control measures (regulation 6(2)), including a timetable for action. Further guidance on what to do is given in Part 2.

Guidance 5(2)(a)

'Observation of specific working practices'

27 To assess the daily exposure to vibration of a worker (or a group of workers doing similar work) it is necessary to know:

(a) which tasks expose employees to vibration;
(b) which employees are exposed;
(c) what equipment they use;
(d) what they use it for;
(e) the total time they are in contact with the equipment while it is operating.

Guidance 5(2)(a)

28 These details can be obtained by observing the employee. The person need not be observed for a complete day, but for a period or periods long enough to provide a representative sample of a typical or average day's exposure to vibration. Observation of the work will generally produce a much more accurate indication of equipment usage time than asking the employee to make an estimate. Work patterns also need careful consideration. For example, some workers may only use vibrating tools for certain periods in a day or week. Typical usage patterns should be established as these will be an important factor in calculating a person's likely vibration exposure. Part 2 and Appendix 1 give more details of how to carry out observation of working practices.

Guidance 5(2)(b)

'Relevant information on the probable magnitude of the vibration'

29 To be relevant, the vibration magnitude you use for your assessment must be representative of the equipment you plan to use and the way in which you plan to use it. There are several possible sources of suitable information on vibration magnitudes. These include:

(a) vibration emission values declared in the equipment handbook;
(b) additional information from the equipment supplier;
(c) internet databases;
(d) research organisations;
(e) vibration consultancies;
(f) HSE's website;
(g) trade associations;
(h) measurements made in your own workplace.

30 However, it is important to check that the vibration data is reasonably representative of your equipment as used in your work activities. Guidance on how to check the suitability of vibration emission data is in paragraphs 4–5 of Appendix 1.

Guidance 5(2)(c)

'If necessary, measurement of the magnitude of vibration'

31 Measurement of vibration magnitude will not usually be required but may be necessary if suitable vibration data are not readily available from sources such as Appendix 3 (also available on HSE's website), from machine manufacturers, or other reliable sources.

32 Measurement is not necessary if you have vibration magnitude data and exposure duration information sufficient for you to make a reasonable estimate of exposure. That is, an estimate of exposure sufficient to demonstrate the likelihood of exposure being at or above the EAV or below the ELV – after taking into account the uncertainties in the magnitude and duration information that you have used.

33 If you remain uncertain whether the EAV is likely to be reached or exceeded, rather than measure, you could simply assume that the value is exceeded and proceed with your programme of control measures and health surveillance (see regulations 6, 7 and 8).

34 Your knowledge of how the vibration magnitude data is obtained, for example measured under conditions not representative of your use of the machine, will affect your confidence in the data. Good quality measurements (see Appendix 2) may provide the reassurance you require. It will usually be necessary to make many measurements for each tool to quantify sufficiently the uncertainty in the measured vibration magnitude to show, for example, that your measured data is more reliable than any existing published data.

35 Measurements may help you to confirm that your control actions have reduced vibration emissions. This is particularly valuable if you need to demonstrate that you have introduced effective controls to keep exposures below the ELV.

Guidance 5(3)(a)

'Magnitude, type and duration of exposure'

36 The factors which govern a person's daily vibration exposure are the magnitude (level) of vibration and the length of time the person is exposed to it. The greater the magnitude and/or the longer the duration of exposure, the greater the person's vibration exposure will be. Other characteristics of the vibration, such as the frequency, may also affect the risk. These are dependent on how the equipment operates, eg hammer action tools and rotary action tools have very different vibration characteristics. The pattern of work may also be relevant, eg intermittent exposures may indicate a lower risk than a long, uninterrupted exposure.

Guidance 5(3)(b)

'Employees whose health is at particular risk'

37 Under regulation 6(6) the measures to be taken must be adapted to take into account employees who are particularly sensitive to vibration. These include:

(a) employees with existing HAVS or other diseases of the hands, arms, wrists or shoulders;
(b) employees with diseases affecting blood circulation, eg primary Raynaud's, or nerve disorders affecting the hands or arms, eg carpal tunnel syndrome.

38 More information about the factors affecting sensitivity is given in Part 3 which contains guidance for occupational health professionals.

Guidance 5(3)(c)

'Any effects of vibration on the workplace and work equipment'

39 Vibration from work equipment can cause damage to other workplace equipment or structures which may create safety risks, eg the risk of materials or equipment falling from overhead platforms or joints moving apart. Vibration may also affect people's ability to read instruments or indicators or to handle controls. You should identify any such risks and take action to control them.

Guidance 5(3)(d)

'Information provided by the manufacturers of work equipment'

40 You should ask the suppliers of hand-held, hand-guided and hand-fed equipment for information on the vibration emission of their products. Manufacturers of machinery are required by the Supply of Machinery (Safety) Regulations 2008 (SMR) to design and construct their products to minimise vibration risks and to provide their customers with information on vibration emissions from their equipment, on safe use of the equipment and to warn of residual risks. Appendix 5 gives guidance on the interpretation of the information provided by equipment manufacturers, importers and suppliers.

Guidance 5(3)(e)

'The availability of replacement equipment designed to reduce exposure to vibration'

41 For many types of equipment there will be models available with reduced vibration emission, eg chainsaws with suspended handles. When buying, hiring or replacing equipment you should take these factors into account so far as is reasonably practicable. However, it is also important to select equipment that is suitable for the work you are going to do and this may not be that with the lowest vibration emission. Your equipment supplier(s) should be able to advise you. When you re-equip, you should check if there are any suitable new models of power tool which would further reduce the vibration risk. It will help your long-term management of work equipment if you introduce a clearly defined purchasing policy for selection of suitable lower-vibration equipment.

Guidance 5(3)(g)

'Specific working conditions such as low temperatures'

42 Working in cold and/or wet conditions can reduce blood flow in the fingers of all people and may trigger attacks of finger blanching (where part of the fingers become white) in people who have HAVS. You should ensure that employees use vibrating equipment in cold and/or wet conditions only when it is unavoidable.

Guidance 5(3)(g)

They must be provided with suitable protective clothing which will allow them to keep warm and dry (see paragraphs 151–153). You should refer to restrictions on exposure of employees with HAVS to cold and/or wet conditions as advised by your occupational health provider.

Guidance 5(3)(h)

'Appropriate information obtained from health surveillance'

43 If you already have a health surveillance programme for HAVS the results (anonymised and grouped to protect medical-in-confidence information about individual workers) should indicate whether new cases of vibration-related disease have appeared or whether existing cases have worsened. This should help you to decide whether the risk is being controlled effectively or whether you need to do more to control it. Published research which includes the effects on the health of workers who have used vibrating equipment similar to that used by your employees may also help you to assess the risk.

Guidance 5(4)

'The risk assessment shall be reviewed regularly'

44 The risk assessment should be reviewed when there is a change to working processes; or in availability or suitability of equipment used to reduce vibration exposure; or if you have any doubt about the effectiveness of the controls implemented and you believe the risk assessment is no longer valid. The frequency of regular review should be sufficient to ensure that changes in risk are observed, taking account of:

(a) the level of exposure;
(b) confidence that your control measures remain effective;
(c) the likelihood of better working methods or equipment becoming available.

Guidance 5(5)

'Record ... the significant findings of the risk assessment'

45 If you have fewer than five employees you don't have to write anything down. But it is useful to do this so you can review it at a later date, for example if something changes. If you have five or more employees you are required to keep a record of the vibration risk assessment. The record of the risk assessment can be kept in any convenient form.

46 Your record must contain information on the significant findings of the assessment and the measures taken (or planned). The record should include:

(a) the employee or job roles assessed;
(b) the likelihood of the exposure action and limit values being exceeded;
(c) the measures you have put in place to control and manage the risk;
(d) a programme of measures, with timescales, for any future controls you plan to introduce;
(e) the appropriate information, instruction and training to be provided to employees (see paragraphs 79–84);
(f) the scheme of health surveillance in use or planned.

47 If the assessment shows that the daily exposures are low (ie clearly below the EAV) then the assessment record should note this. A record of low exposure should also note any duties arising for exposures below the EAV, for example, concerning employees already diagnosed with HAVS.

Regulation 6 Elimination or control of exposure to vibration at the workplace

Regulation 6

(1) The employer shall ensure that risk from the exposure of his employees to vibration is either eliminated at source or, where this is not reasonably practicable, reduced to as low a level as is reasonably practicable.

Regulation 6

(2) Where it is not reasonably practicable to eliminate risk at source pursuant to paragraph (1) and an exposure action value is likely to be reached or exceeded, the employer shall reduce exposure to as low a level as is reasonably practicable by establishing and implementing a programme of organisational and technical measures which is appropriate to the activity.

(3) The measures taken by the employer in compliance with paragraphs (1) and (2) shall be based on the general principles of prevention set out in Schedule 1 to the Management of Health and Safety at Work Regulations 1999 and shall include consideration of –

- *(a) other working methods which eliminate or reduce exposure to vibration;*
- *(b) choice of work equipment of appropriate ergonomic design which, taking account of the work to be done, produces the least possible vibration;*
- *(c) the provision of auxiliary equipment which reduces the risk of injuries caused by vibration;*
- *(d) appropriate maintenance programmes for work equipment, the workplace and workplace systems;*
- *(e) the design and layout of workplaces, work stations and rest facilities;*
- *(f) suitable and sufficient information and training for employees, such that work equipment may be used correctly and safely, in order to minimise their exposure to vibration;*
- *(g) limitation of the duration and magnitude of exposure to vibration;*
- *(h) appropriate work schedules with adequate rest periods; and*
- *(i) the provision of clothing to protect employees from cold and damp.*

(4) Subject to regulation 3(2) and (3) and paragraph (5), the employer shall –

- *(a) ensure that his employees are not exposed to vibration above an exposure limit value; or*
- *(b) if an exposure limit value is exceeded, he shall forthwith –*
  - *(i) reduce exposure to vibration to below the limit value;*
  - *(ii) identify the reason for that limit being exceeded; and*
  - *(iii) modify the measures taken in accordance with paragraphs (1) and (2) to prevent it being exceeded again.*

(5) Paragraph (4) shall not apply where the exposure of an employee to vibration is usually below the exposure action value but varies markedly from time to time and may occasionally exceed the exposure limit value, provided that –

- *(a) any exposure to vibration averaged over one week is less than the exposure limit value;*
- *(b) there is evidence to show that the risk from the actual pattern of exposure is less than the corresponding risk from constant exposure at the exposure limit value;*
- *(c) risk is reduced to as low a level as is reasonably practicable, taking into account the special circumstances; and*
- *(d) the employees concerned are subject to increased health surveillance, where such surveillance is appropriate within the meaning of regulation 7(2),*

and exposure within the meaning of this paragraph shall be ascertained on the basis set out in Schedule 1 Part II for hand-arm vibration and Schedule 2 Part II for whole-body vibration.

(6) The employer shall adapt any measure taken in compliance with the requirements of this regulation to take account of any employee or group of employees whose health is likely to be particularly at risk from vibration.

Guidance 6

Control of exposure

48 Regulation 6 means you have to take action to eliminate the risks from vibration when it is reasonably practicable to do so (regulation 6(1)). Paragraphs 50–70 explain what some of the terms in regulation 6 mean. You will need to consider whether there are alternative processes, better equipment and/or better working methods which would largely eliminate vibration risks.

49 If it is not reasonably practicable to eliminate the risks completely, you should reduce them to 'as low a level as is reasonably practicable' (regulation 6(1)). It is important to note that exposures below the EAV are not risk-free, so action should not stop at this level of exposure if further reductions can be achieved at a reasonable cost. You should:

(a) introduce control measures whenever an employee's daily exposure to vibration is likely to reach or exceed the EAV (regulation 6(2));
(b) not expose anyone above the ELV (regulation 6(4)).

Guidance 6(2)

'Establishing and implementing a programme of organisational and technical measures'

50 The programme produced during your vibration risk assessment should describe a plan of control measures and your plans to put it into action within realistic timescales. Such a programme is required when your vibration assessment shows that any of your employees are likely to be exposed at or above the EAV.

51 The control measures should be devised to reduce the risks from vibration exposure to ALARP. The actions you take will depend on the particular work activities and processes and the possibilities for control. Further guidance on selecting and introducing suitable controls is given in Part 2.

52 Some controls may take time to put in place, particularly where equipment must be replaced or new industrial processes developed. The programme should state clearly which managers, supervisors and employees have responsibility for delivering the various parts of the programme and by when.

Guidance 6(3)

'The general principles of prevention'

53 Schedule 1 of the Management of Health and Safety at Work Regulations 1999[12] lists the general principles of prevention:

(a) avoiding risks;
(b) evaluating the risks which cannot be avoided;
(c) combating the risks at source;
(d) adapting the work to the individual, especially regarding the design of workplaces, the choice of work equipment and the choice of working and production methods, with a view, in particular, to alleviating monotonous work and work at a predetermined work-rate and to reducing their effect on health;
(e) adapting to technical progress;
(f) replacing the dangerous by the non-dangerous or the less dangerous;
(g) developing a coherent overall prevention policy which covers technology, organisation of work, working conditions, social relationships and the influence of factors relating to the working environment;
(h) giving collective protective measures priority over individual protective measures;
(i) giving appropriate instructions to employees.

54 The list of possible control measures in regulation 6(3) is specific to vibration but follows similar principles.

Guidance 6(3)(a)

'Other working methods which eliminate or reduce exposure'

55 Other methods of work which can eliminate or reduce exposure to vibration include automation or mechanisation of work previously done with hand-operated or hand-fed machines. For example, a hand-operated pneumatic road breaker might be replaced in some work activities by a hydraulic pick mounted on an excavator arm, or a hand-held tamper replaced by a stand-mounted tamper when compacting sand-filled moulds.

Guidance 6(3)(b)

'Choice of work equipment of appropriate ergonomic design'

56 The work equipment you select must be suitable for the task. Some machines can emit significantly lower levels of vibration than their competitors and/or may be easier to use, eg lighter weight and ergonomically designed to avoid strain on the user's hands and arms. In addition, the efficiency of the tool should be taken into account when evaluating exposure.

Guidance 6(3)(c)

'The provision of auxiliary equipment'

57 Auxiliary equipment which can affect the risk of vibration injuries includes consumables, anti-vibration handles and machine balancers. Selecting alternative consumables (eg balanced grinding wheels, drill tips or chisels designs) or fitting anti-vibration handles may reduce vibration emission of machines. Balancers or tensioners (that help support the weight of the tool and facilitate use of the tool with light grip and feed forces) change the way vibration is transmitted to the user.

58 Selection of the correct auxiliary equipment for the job will reduce vibration exposure and/or vibration risk. Selecting unsuitable equipment will increase vibration risk. Manufacturers can usually advise on what auxiliary equipment is approved by them for use with their machines (non-approved auxiliary equipment may affect the safe use of the machine and should not be used).

Guidance 6(3)(d)

'Appropriate maintenance programmes'

59 Maintenance of machinery, undertaken in accordance with the manufacturer's recommendations, should prevent unnecessarily high-vibration emissions resulting from worn parts, loose components etc. Operators should be instructed to report any unusually high vibration levels and to sharpen or replace consumables (grinding wheels, drills, chisels etc) when necessary.

Guidance 6(3)(e)

'The design and layout of workplaces, work stations…'

60 The design and layout of work stations should follow good ergonomic principles to facilitate working in neutral postures and with minimal grip and feed forces. Manufacturers may also provide guidance on safe use of their equipment.

Guidance 6(3)(f)

'Suitable and sufficient information and training for employees'

61 See regulation 8 for guidance on information and training for employees.

Guidance 6(3)(g)

'Limitation of the duration and magnitude of exposure'

62 When all reasonably practicable steps have been taken to reduce the vibration magnitude, the final resort for compliance with the ELV is to limit the duration of exposure. The exposure points systems (see Appendix 1) can be a useful management tool for this purpose.

Guidance 6(3)(h)

'Appropriate work schedules with adequate rest periods'

63 It is advisable to schedule short periods of exposure with frequent breaks rather than have long uninterrupted vibration exposures.

Guidance 6(3)(i)

'Protect employees from cold and damp'

64 Ensure your employees are able to keep warm and dry, wherever possible, as this will help to maintain good blood circulation and reduce the likelihood of vascular symptoms (finger blanching).

Guidance 6(4)

'Ensure ... employees are not exposed ... above the exposure limit value'

65 You must not permit an employee to be exposed above the ELV. Your programme of measures must be designed to prevent this level of exposure. If you find that the ELV is being exceeded, you must immediately take action to reduce exposure and identify the reason for the over exposure.

66 You should not consider reduction below the ELV to be a target – you must reduce exposure as low as you reasonably can, and below the EAV if this is reasonably practicable (risks are still significant for exposures between the two values and some people will still be at risk if exposed at the action value). This may mean reducing the time for which the employee uses the equipment each day, eg spreading that particular task over several days or sharing it between two or more employees.

Guidance 6(5)

'Exposure averaged over one week'

67 Weekly averaging of daily exposure allows for occasional daily exposures above the ELV. However, there are stringent conditions for its use. Regulations 6(1) and 6(2) still apply and it will often be reasonably practicable to spread the exposure over more than one day to keep each day's exposure below the ELV. Also, to qualify for weekly averaging exposures must be reduced to ALARP, taking account of the special circumstances. They must also usually be (ie on most days) below the EAV. Where weekly averaging is used, you should also increase the health surveillance of employees. Weekly averaging is most likely to apply in cases of emergency work, eg involving the rescue services or intensive urgent work using chainsaws to clear fallen trees following a storm etc.

68 The value obtained for $A(8)_{week}$ according to the formula provided in Part II of Schedule 1 may be compared with the ELV in the usual way.

69 The weekly averaging scheme would permit a maximum exposure on any one day of 11 m/s^2 $A(8)$ when exposure on the remaining days of the week is zero, or 10 m/s^2 $A(8)$ when exposure on each of the other four days of the week is just below 2.5 m/s^2 $A(8)$, the EAV.

'Employees ... likely to be particularly at risk from vibration'

70 Paragraphs 37–38 describes the employees in this category.

Regulation 7 Health surveillance

Regulation 7

(1) If –

(a) the risk assessment indicates that there is a risk to the health of his employees who are, or are liable to be, exposed to vibration; or

(b) employees are likely to be exposed to vibration at or above an exposure action value,

the employer shall ensure that such employees are placed under suitable health surveillance, where such surveillance is appropriate within the meaning of paragraph (2).

(2) Health surveillance, which shall be intended to prevent or diagnose any health effect linked with exposure to vibration, shall be appropriate where the exposure of the employee to vibration is such that –

(a) a link can be established between that exposure and an identifiable disease or adverse health effect;

(b) it is probable that the disease or effect may occur under the particular conditions of his work; and

Regulation 7

(c) there are valid techniques for detecting the disease or effect.

(3) The employer shall ensure that a health record in respect of each of his employees who undergoes health surveillance in accordance with paragraph (1) is made and maintained and that the record or a copy thereof is kept available in a suitable form.

(4) The employer shall –

(a) on reasonable notice being given, allow an employee access to his personal health record; and
(b) provide the enforcing authority with copies of such health records as it may require.

(5) Where, as a result of health surveillance, an employee is found to have an identifiable disease or adverse health effect which is considered by a doctor or other occupational health professional to be the result of exposure to vibration the employer of that employee shall –

(a) ensure that a suitably qualified person informs the employee accordingly and provides the employee with information and advice regarding further health surveillance, including any health surveillance which he should undergo following the end of the exposure;
(b) ensure that he is himself informed of any significant findings from the employee's health surveillance, taking into account any medical confidentiality;
(c) review the risk assessment;
(d) review any measure taken to comply with regulation 6, taking into account any advice given by a doctor or occupational health professional or by the enforcing authority;
(e) consider assigning the employee to alternative work where there is no risk from further exposure to vibration, taking into account any advice given by a doctor or occupational health professional; and
(f) provide for a review of the health of any other employee who has been similarly exposed, including a medical examination where such an examination is recommended by a doctor or occupational health professional or by the enforcing authority.

(6) An employee to whom this regulation applies shall, when required by his employer and at the cost of his employer, present himself during his working hours for such health surveillance procedures as may be required for the purposes of paragraph (1).

Guidance 7(1)

'Suitable health surveillance'

71 Health surveillance is a programme of systematic health checks to identify early signs and symptoms of disease and to allow action to be taken to prevent its progression. It is also useful in assessing the effectiveness of your controls. This regulation requires employers to introduce suitable health surveillance for those of their employees who are at risk from exposure to HAV. Detailed guidance on suitable health surveillance for HAVS is given in Part 3.

Guidance 7(1,2)

'Where such surveillance is appropriate'

72 Health surveillance must be provided not only for employees likely to be exposed at or above the EAV but also for others whom the risk assessment identifies may be at risk, eg employees who are particularly sensitive to vibration (see paragraphs 37–38). Health surveillance is not appropriate for individuals whose daily exposures reach or exceed the EAV only on rare occasions and where the risk assessment identifies that the risk of ill health is consequently very low.

Guidance 7(3,4)

'Health records'

73 These records will contain information on the outcome of the health surveillance in terms of the individual's fitness to continue to work with vibration exposure. They should not contain confidential medical information, which should be kept in the medical record held by the occupational health professional. See Part 3.

Guidance 7(5)

Action required when health surveillance reveals that any employees have suffered ill health as a result of exposure to vibration

74 Those employees who have been diagnosed with a relevant condition should have the significance of the results explained to them by an occupational health professional and be given advice on the risks of continuing with vibration exposure.

75 The occupational health professional should inform you (the employer) of the findings of health surveillance procedures, in particular whether or not the employee is fit to continue work involving exposure to vibration and whether any restrictions are required. However, they will not disclose medical-in-confidence information to you without the written consent of the employee.

76 You should prevent further harm to the individual by acting on any advice from the occupational health professional and, where necessary, removing the employee from exposure to HAV. You should review your vibration risk assessment to decide whether to take action to protect the rest of the workforce. Where other workers have similarly been exposed to HAV you should arrange for them to be placed under health surveillance.

77 Anonymised health surveillance results for groups of employees should help you assess how well your vibration risk control programme is working. Such information should be suitably adapted to protect individuals' identities and be made available to safety or employee representatives.

Guidance 7(6)

Attendance for health surveillance

78 Regulation 7(6) requires your employees to co-operate with your health surveillance programme by attending their health surveillance appointments. You must arrange for this in normal working hours and cover any costs (eg lost earnings, travel). Where applicable, you should consult with employee representatives and the employees concerned before introducing health surveillance. It is important that your employees understand that the aim of health surveillance is to protect them from developing advanced symptoms of ill health so that their ability to continue to work is not affected. You will need their understanding and co-operation if health surveillance is to be effective.

Regulation 8 Information, instruction and training

Regulation 8

(1) If –

(a) the risk assessment indicates that there is a risk to the health of his employees who are, or who are liable to be, exposed to vibration; or

(b) employees are likely to be exposed to vibration at or above an exposure action value,

the employer shall provide those employees and their representatives with suitable and sufficient information, instruction and training.

Regulation 8

(2) Without prejudice to the generality of paragraph (1), the information, instruction and training provided under that paragraph shall include –

(a) the organisational and technical measures taken in order to comply with the requirements of regulation 6;
(b) the exposure limit values and action values set out in regulation 4;
(c) the significant findings of the risk assessment, including any measurements taken, with an explanation of those findings;
(d) why and how to detect and report signs of injury;
(e) entitlement to appropriate health surveillance under regulation 7 and its purposes;
(f) safe working practices to minimise exposure to vibration; and
(g) the collective results of any health surveillance undertaken in accordance with regulation 7 in a form calculated to prevent those results from being identified as relating to a particular person.

(3) The information, instruction and training required by paragraph (1) shall be updated to take account of significant changes in the type of work carried out or the working methods used by the employer.

(4) The employer shall ensure that any person, whether or not his employee, who carries out work in connection with the employer's duties under these Regulations has suitable and sufficient information, instruction and training.

Guidance 8

Information, instruction and training for employees

79 You should share the significant findings of your risk assessment (see paragraphs 45–47) with your exposed employees and their representatives. Employees should be properly trained to carry out their jobs safely. Regulation 8(2) lists some of the issues that must be covered, but it is not exhaustive.

80 Employers should ensure that employees fully understand the level of risk they may be exposed to, how it is caused and the possible health effects, ie:

(a) which work equipment and processes cause vibration risks and their respective levels of risk;
(b) how their personal daily exposures compare with the exposure action and limit values;
(c) what symptoms of ill health they should look out for, to whom they should report them and how they should report them;
(d) what control measures you have taken and/or plan to introduce to reduce risks;
(e) the use of personal protective equipment where required, eg special clothing required to keep the body and/or hands warm;
(f) what training is in place and/or you plan for operators, supervisors and managers in their respective roles to ensure control of exposure, eg through correct selection, use and maintenance of equipment or restriction of exposure times;
(g) what health surveillance has been provided and/or will be provided, how you are going to provide it and why it is important, as well as the overall findings (in anonymous form);
(h) employees are expected to:
  (i) follow instructions they are given on safe working practices;
  (ii) report problems with their equipment, such as unusually high vibration levels;
  (iii) co-operate with your programme of control measures and health surveillance.

Guidance 8

81 You can provide the information, instruction and training (which can be informal) using different approaches, including:

(a) presentations;
(b) computer-based training;
(c) individual counselling and training;
(d) leaflets and posters;
(e) videos;
(f) short local training sessions.

82 No single way will be suitable for all circumstances and you will need to reinforce the messages from time to time, eg by giving toolbox talks. You could draw employees' attention to any relevant advice provided by HSE, trade associations etc and provide them with the HSE pocket card *Hand-arm vibration: A guide for employees*.

83 You should make sure that you give the information in a way in which the employee can be expected to understand (eg you might need to make special arrangements if the employee is not fluent in English or has difficulty reading).

84 Working with trade-union-appointed safety representatives or other employee representatives can be a very useful means of communicating and reinforcing health and safety matters in your workplace. You are required by the Safety Representatives and Safety Committees Regulations 1977,[13, 14] and the Offshore Installations (Safety Representatives and Safety Committees) Regulations 1989[15] to make certain information available to safety representatives appointed under the Regulations. The representatives are entitled to see some of your documents, which will normally include your vibration assessment and action plan covering those employees represented. You should make sure the representatives know how the information can be obtained and give them any necessary explanation of their meaning. There is also a duty on you to provide information to employee representatives elected under the Health and Safety (Consultation with Employees) Regulations 1996,[13, 14] which apply to groups of workers who are not covered by a trade-union-appointed safety representative.

Guidance 8(4)

Information, instruction and training in connection with the employer's duties

85 Anyone who helps you to comply with your duties under the Vibration Regulations (for example, by making vibration measurements, determining exposures or planning for control of risk through changes to industrial processes or working practices) must have suitable and sufficient information, instruction and training. This means that they must be competent to undertake this responsibility.

86 Whether you employ a consultant or use members of your staff to help you comply with your duties, you should ensure that they have the necessary understanding and experience. Appendix 7 contains guidance on appropriate levels of knowledge and expertise for competent assessment and management of HAV.

Regulation 9 Exemption certificates for emergency services

Regulation 9

(1) Subject to paragraph (2), the Executive may, by a certificate in writing, exempt any person or class of persons from regulation 6(4) in respect of activities carried out by emergency services which conflict with the requirements of that paragraph,

Regulation 9

and any such exemption may be granted subject to conditions and to a limit of time and may be revoked by a certificate in writing at any time.

(2) The Executive shall not grant any such exemption unless it is satisfied that the health and safety of the employees concerned is ensured as far as possible in the light of the objectives of these Regulations.

Guidance 9

87 Any emergency service wishing to seek exemption under this regulation should contact HSE for further advice. HSE is likely only to consider applications made in relation to an emergency service as a whole rather than from local units.

Regulation 10 Exemption certificates for air transport

Regulation 10

(1) Subject to paragraph (2), the Executive may, by a certificate in writing, exempt any person or class of persons from regulation 6(4) in respect of whole-body vibration in the case of air transport, where the latest technical advances and the characteristics of the workplace do not permit compliance with the exposure limit value despite the technical and organisational measures taken, and any such exemption may be granted subject to conditions and to a limit of time and may be revoked by a certificate in writing at any time.

(2) The Executive shall not grant any such exemption unless –

- *(a) it consults the employers and the employees or their representatives concerned;*
- *(b) the resulting risks are reduced to as low a level as is reasonably practicable; and*
- *(c) the employees concerned are subject to increased health surveillance, where such surveillance is appropriate within the meaning of regulation 7(2).*

Regulation 11 Exemptions relating to the Ministry of Defence

Regulation 11

(1) Subject to paragraph (2), the Secretary of State for Defence may, by a certificate in writing, exempt any person or class of persons from regulation 6(4) in respect of activities carried out in the interests of national security which conflict with the requirements of that paragraph, and any such exemption may be granted subject to conditions and to a limit of time and may be revoked by a certificate in writing at any time.

(2) The Secretary of State shall not grant any such exemption unless he is satisfied that the health and safety of the employees concerned is ensured as far as possible in the light of the objectives of these Regulations.

Regulation 12 Extension outside Great Britain

Regulation 12

(1) These Regulations shall apply to and in relation to any activity outside Great Britain to which sections 1 to 59 and 80 to 82 of the 1974 Act apply by virtue of the Health and Safety at Work etc Act 1974 (Application outside Great Britain) Order 2001 as those provisions apply within Great Britain.*

** Replaced by the Health and Safety at Work etc Act 1974 (Application outside Great Britain) Order 2013.*

Guidance 12

88 These Regulations apply to all work activities on offshore installations, wells, pipelines and pipelines works and to certain connected activities within the territorial waters of Great Britain or in designated areas of the UK Continental Shelf. They also apply to certain other activities within territorial waters, including the construction and operation of wind farms.

Regulation 13 Amendments

Regulation 13

(1) In the Offshore Installations and Wells (Design and Construction etc) Regulations 1996, paragraph 67 of Schedule 1 shall be omitted.

(2) In the Provision and Use of Work Equipment Regulations 1998, to the end of the list in regulation 12(5) add –

"(g) the Control of Vibration at Work Regulations 2005".

Schedule 1 Hand-arm vibration

Regulations 4(1) and 6(5)

Guidance

Schedule 1

89 This Schedule provides definitions of HAV exposure relevant to the exposure action and limit values set out in the Regulations. The Schedule is not generally intended to be used by employers, who should be able to assess daily vibration exposure adequately by following the guidance in this book.

Schedule 1

Part I: Daily exposure to vibration

The daily exposure to vibration (A(8)) of a person is ascertained using the formula:

$$A(8) = a_{hv}\sqrt{\frac{T}{T_0}}$$

where:

a_{hv} *is the vibration magnitude, in metres per second squared (m/s²);*

T *is the duration of exposure to the vibration magnitude* a_{hv}*; and*

T_0 *is the reference duration of 8 hours (28,800 seconds).*

To avoid confusion between vibration magnitude and daily exposure to vibration, it is conventional to express daily exposure to vibration in m/s² A(8).

The vibration magnitude, a_{hv}*, is ascertained using the formula:*

$$a_{hv} = \sqrt{a^2_{hwx} + a^2_{hwy} + a^2_{hwz}}$$

where:

a_{hwx}*,* a_{hwy} *and* a_{hwz} *are the root-mean-square acceleration magnitudes, in m/s², measured in three orthogonal directions, x, y and z, at the vibrating surface in contact with the hand, and frequency-weighted using the weighting* W_h*.*

The definition for the frequency weighting W_h *is given in British Standard BS EN ISO 5349-1:2001.*

Where both hands are exposed to vibration, the greater of the two magnitudes a_{hv} *is used to ascertain the daily exposure.*

If the work is such that the total daily exposure consists of two or more operations with different vibration magnitudes, the daily exposure (A(8)) for the combination of operations is ascertained using the formula:

$$A(8) = \sqrt{\frac{1}{T_0}\sum_{i=1}^{n} a^2_{hvi} T_i}$$

where:

n *is the number of individual operations within the working day;*

Schedule 1

a_{hvi} is the vibration magnitude for operation i; and

T_i is the duration of operation i.

Part II: Exposure to vibration averaged over one week

The exposure to vibration averaged over one week ($A(8)_{week}$) is the total exposure occurring within a period of seven consecutive days, normalised to a reference duration of five 8-hour days (40 hours). It is ascertained using the formula:

$$A(8)_{week} = \sqrt{\frac{1}{5}\sum_{j=1}^{7} A(8)_j^2}$$

where:

$A(8)_j$ is the daily exposure for day j.

The exposure to vibration averaged over one week is for use only for the purposes of Regulation 6(5).

Schedule 2

Schedule 2 Whole-body vibration

Regulations 4(2) and 6(5)

Part I: Daily exposure to vibration

The daily exposure to vibration (A(8)) of a person is ascertained using the formula:

$$A(8) = k a_w \sqrt{\frac{T}{T_0}}$$

where:

a_w is the vibration magnitude (root-mean-square frequency-weighted acceleration magnitude) in one of the three orthogonal directions, x, y and z, at the supporting surface;

T is the duration of exposure to the vibration magnitude a_w;

T_0 is the reference duration of 8 hours (28,800 seconds); and

k is a multiplying factor.

To avoid confusion between vibration magnitude and daily exposure to vibration, it is conventional to express daily exposure to vibration in m/s^2 A(8).

Daily exposure to vibration (A(8)) is evaluated separately for the x, y and z directions of vibration.

For horizontal vibration (x and y directions), k = 1.4 and a_w is obtained using the W_d frequency weighting. For vertical vibration (z direction), k = 1.0 and a_w is obtained using the W_k frequency weighting.

Definitions for the frequency weightings are given in International Standard ISO 2631-1:1997.

If the work is such that the total daily exposure consists of two or more operations with different vibration magnitudes, the daily exposure (A(8)) for the combination of operations is ascertained using the formula:

$$A(8) = \sqrt{\frac{1}{T_0} \sum_{i=1}^{n} a_{wi}^2 T_i}$$

where:

n is the number of individual operations within the working day;

a_{wi} is the vibration magnitude for operation i; and

T_i is the duration of operation i.

Schedule 2

Part II: Exposure to vibration averaged over one week

The exposure to vibration averaged over one week ($A(8)_{week}$) is the total exposure occurring within a period of seven consecutive days, normalised to a reference duration of five 8-hour days (40 hours). It is ascertained using the formula:

$$A(8)_{week} = \sqrt{\frac{1}{5}\sum_{j=1}^{7} A(8)_j^2}$$

where:

$A(8)_j$ *is the daily exposure for day j.*

The exposure to vibration averaged over one week is for use only for the purposes of Regulation 6(5).

PART 2 Management and control of risk from hand-arm vibration

General

90 Part 2 provides a guide to the practical steps you can take to reduce risk from exposure to vibration to the lowest level reasonably practicable. By following this guidance you will normally be doing enough to comply with the law. The information in this part covers the management of vibration risk, including:

(a) assessing vibration exposures;
(b) planning for vibration control;
(c) applying the hierarchy of control.

91 Your assessment of vibration should first consider the actions that could be taken to reduce vibration exposure. The hierarchy for control which minimises the risk from vibration exposure, in order of priority, is as follows:

(a) Eliminate vibration exposure by changing the work processes.
(b) Reduce exposure by mechanisation.
(c) Reduce exposure by good process control.
(d) Avoid high-vibration tools, machines and accessories.
(e) Maintain machines and accessories.
(f) Reduce the transmission of vibration into the hand.
(g) Reduce the durations of exposure (including job rotation).
(h) Keep warm and dry.

92 To decide which of your identified actions are reasonably practicable, you will need to consider vibration exposures, costs, ease of implementation and other factors. When it is reasonably practicable for you to take action to reduce vibration exposure you should do this, whether or not exposure is at or above the EAV. Exposures below the EAV are not necessarily safe; although vibration-related ill health is unreported for exposures below 1 m/s^2 $A(8)$, as explained in the Annex C to BS EN ISO 5349-1:2001.[16]

93 You should use vibration exposure values as a guide to risk and to determine your duties under the Vibration Regulations. Health surveillance can be used as one of the means to identify any weaknesses in the controls you have implemented and to prevent disability in employees who develop symptoms of vibration disease.

94 Your estimates of exposure should be fit for purpose. They can be simple at first, concentrating on the time a person uses the machines required for the job and establishing what vibration information is available that is representative of the person's use of the machines.

95 If your preliminary assessment shows exposures at or above the EAV, and there is some doubt concerning the actions available to control exposure, it may be appropriate to make a more detailed assessment of exposure to help determine what action is reasonably practicable and required by law.

Assessing vibration risk and planning for risk control

96 The Vibration Regulations require that you make a 'suitable and sufficient' assessment of the risks from vibration. This risk assessment should identify the measures that need to be taken to meet the requirements of the regulations. You

should keep a record of your risk assessment. The exact content of a record of a suitable and sufficient assessment will change according to the circumstances but will contain the date of the assessment, who made the assessment, and will usually include at least:

(a) the employee or job roles assessed:
  (i) the tasks, operations and processes;
  (ii) a description of the power tools, machines, workpieces, method of working etc;
  (iii) the regularity and frequency of exposure to vibration and, if the exposure patterns change, how they change over weeks, months and longer;
  (iv) any information, eg from (anonymised) health surveillance results, associating the task with HAVS;

(b) the likelihood of the exposure action and limit values being exceeded:
  (i) the likely vibration magnitudes (levels) and sources of this information (manufacturers' information, databases, your own measurements, consultants' advice etc);
  (ii) estimates of daily exposure duration associated with each vibration magnitude
  (iii) the people whose daily vibration exposures are likely to reach or exceed the EAV and/or exceed the ELV;
  (iv) the duties arising under regulations 6, 7 and 8 (requirements for reduction of risk and exposure, health surveillance, information and training etc);

(c) the measures you have put in place to control and manage the risk:
  (i) the steps, if any, to ensure exposure remains below the ELV;
  (ii) the factors that prevent further reasonably practicable reductions in exposure;

(d) a programme of measures, with timescales, for any future controls you plan to introduce:
  (i) identification of the measures likely to reduce exposure to vibration, and the resources that would be required (see guidance on regulation 6);
  (ii) any further information necessary to help you comply with your duties to reduce exposure and control risk;
  (iii) persons (eg managers, supervisors and operators) for carrying out the items of work described in the action plan;
  (iv) timetables for implementation of the work items in the action plan;

(e) the appropriate information, instruction and training to be provided to employees (see paragraphs 79–84);

(f) the scheme of health surveillance in use or planned:
  (i) any susceptibility identified in your employees;
  (ii) persons (eg managers, supervisors) for reviewing (anonymised) health surveillance data and assessing the implications for the current and planned control measures.

Evaluation of vibration risk

Daily vibration exposure

97 The daily vibration exposure is an indication of the level of risk to health. Some of the duties in the Vibration Regulations are triggered when daily vibration exposures reach certain values. For example, if the exposure is likely to exceed the ELV (5 m/s^2 *A*(8)), the risk is high and the Vibration Regulations require you to take immediate action to prevent further exposure above this level; when exposure is

likely to reach or exceed the EAV (2.5 m/s^2 *A*(8)), you have duties to have a formal programme of measures to minimise risk, including exposure controls, health surveillance and training. The risk must be controlled, so far as is reasonably practicable, at any level of exposure.

98 A person's daily vibration exposure depends on:

(a) the vibration magnitudes to which they are exposed;
(b) how long the exposures last.

99 Estimation of exposure (see Appendix 1) needs to be sufficiently precise to determine the likelihood that the exposure will reach or exceed the EAV or to establish that it is at or below the ELV. A rough estimate may be sufficient when exposures are much higher (or much lower) than the EAV, but much more care is required to demonstrate satisfactorily that exposures reduced so far as is reasonably practicable are, in fact, below the exposure action or limit value.

100 Representative vibration magnitudes (see Appendix 3) and observed exposure durations are usually adequate to assess vibration exposure with sufficient precision for comparison with the EAV and ELV of the Vibration Regulations.

101 There are times when vibration measurements are necessary. Such times include:

(a) when it is not clear from the information otherwise available whether the daily exposure is likely to be at or below the ELV or EAV;
(b) when you need to check the effectiveness of actions taken to control vibration exposure by making before and after measurements;
(c) when a machine is used for an unusual purpose, of which the manufacturer approves but has limited previous experience and so cannot provide vibration information.

Guidance on measuring vibration magnitude is given in Appendix 2.

The relationship between vibration magnitude, duration of exposure and daily vibration exposure (*A*(8) value)

102 A person's daily vibration exposure is, like the vibration magnitude, expressed in acceleration units of m/s^2. The daily exposure can be thought of as the average vibration spread over a standard working day of eight hours, adjusted to take account of the actual total exposure duration (ie contact time or trigger time). To avoid confusion with vibration magnitudes, it is conventional to add *A*(8) after the units when quoting a daily vibration exposure; for example, 2.5 m/s^2 *A*(8).

103 Table 1 gives a range of example vibration magnitudes, together with the corresponding exposure times that result in exposures at the EAV and at the ELV. For example, at a vibration magnitude of 8 m/s^2, it would take just three-quarters of an hour to reach the 2.5 m/s^2 *A*(8) EAV and three hours to reach the 5 m/s^2 *A*(8) ELV.

Table 1 Example vibration magnitudes and exposure times required to reach the EAV of 2.5 m/s^2 *A*(8) and the ELV of 5 m/s^2 *A*(8)

Vibration magnitude (m/s^2)	2	2.5	3	4	5	6	7	8	10	14	20
Time to reach exposure action value (hours)	12½	8	5½	3	2	1½	1	¾	½	¼	7 min
Time to reach exposure limit value (hours)	>24	>24	22¼	12½	8	5½	4	3	2	1	½

104 If the total exposure time happens to be exactly eight hours (unlikely in practice), then the daily vibration exposure has the same value as the average vibration magnitude. For example, if someone is exposed to vibration at 3 m/s^2 for a total of eight hours in a day, their daily exposure will be 3 m/s^2 *A*(8). If the exposure time is less than eight hours (typically the case) their exposure is less than 3 m/s^2 *A*(8). If that employee's daily exposure time is more than eight hours (possible if long shifts are worked) then their exposure is greater than 3 m/s^2 *A*(8).

Using exposure duration as an indicator of risk

105 Determination of the duration(s) of exposure to vibration alone can be sufficient to indicate the likelihood that the EAV or ELV will be reached or exceeded. For example, small, good-quality, modern, rotary-action powered hand tools, such as angle grinders, often have a vibration emission of about 7 m/s^2, and a user's exposure should be expected to exceed the EAV after being exposed to the vibration for about one hour and the ELV after about four hours (see rotary machines in Table 2).

106 Good-quality, modern, impulsive-action power tools, such as chipping hammers or rotary hammers, often have a vibration emission of about 15 m/s^2, and a user's exposure should be expected to exceed the EAV after use for about a quarter of an hour and the ELV after about one hour (see percussive machines in Table 2).

Table 2 Durations after which it is likely that the action value or limit value will have been reached

Power tool or machine type	Time to EAV	Time to ELV
Rotary	1 hour	4 hours
Percussive	15 mins	1 hour
Note 1: Employers should hold information to justify usage beyond the times indicated in this table; for example, machines that incorporate effective vibration-reducing design features may have lower vibration magnitudes, allowing longer use before the action values are reached.		
Note 2: The exposure durations shown are those after which it is likely that the EAV or ELV will have been reached with **modern well-designed and maintained machines**. Older, poorly designed or poorly maintained machines may reach the EAV and ELV much sooner.		

107 In many cases, careful observation of duration(s) of exposure is likely to be required, especially for machines that are used many times a day but for only a few minutes or seconds each time. Timing using mobile phones or watches with stopwatch functionality is generally adequate.

108 Operators may be able to provide accurate estimates for equipment used continuously for long periods of time, such as a lawnmower. However, in general, workers significantly over-estimate their usage times as equipment is often used intermittently.

Calculating daily exposure

109 A worker's daily vibration exposure depends on:

(a) the vibration magnitude at the surface in contact with the hand, in units of m/s^2 (where both hands are in contact with vibration the daily vibration exposure is based on the higher vibration magnitude);
(b) the duration of exposure (the time for which an employee's hand is actually in contact with that vibration, ie trigger time), usually in minutes or hours.

Sources of vibration magnitude

110 Table 2 can be used as an indicator of your employee's exposure for comparison with EAV and ELV and identify your duties under the Vibration Regulations. You can refine your estimate of exposure by finding vibration magnitude information that is representative of the work you are assessing (see Appendix 3).

111 Other information on vibration magnitudes includes advice provided by manufacturers or suppliers of power tools and other machinery, trade associations and others who have experience of the work processes and tools used. HSE may, from time to time, update or extend the range of examples posted on its HAV webpages (www.hse.gov.uk/vibration).

112 Care should be taken to ensure that the vibration magnitude and the duration of exposure are suitably matched (see Appendix 1).

113 When you have obtained vibration magnitudes for each model of tool or vibrating process used on a job, and corresponding exposure durations for each of them, you can calculate the daily vibration exposure for each employee, group of employees, or job. The method of calculating vibration exposure is set out in Schedule 1 to the Vibration Regulations. The calculation of exposures in accordance with Schedule 1 is discussed further in Appendix 1. To assist you with calculation of vibration exposures, HSE has developed a 'ready-reckoner' and a spreadsheet calculator.

Ready-reckoner

114 Appendix 1 provides a ready-reckoner for determining daily vibration exposures. If more than one machine is used during a day the ready-reckoner allows the contributions from each machine to be easily added to obtain an overall daily exposure.

The HSE calculator

115 An exposure calculator (Microsoft Excel spreadsheet) is available on HSE's HAV webpages (see Appendix 1). The calculator allows vibration magnitude and exposure time information to be entered for the different machines or processes used by an individual and displays the overall daily vibration exposure.

Other factors affecting risk

116 In addition to vibration exposure, you should consider factors such as:

(a) the conditions in the workplace, particularly temperature;
(b) postures adopted to do the work;
(c) forces applied by the operator to the machine.

117 Your assessment of risk should take account of individuals who are particularly susceptible to vibration injury. Employees whose health is at particular risk from vibration include those who have been previously diagnosed with HAVS, or suffer from disorders which could affect the hands, arms, wrists or shoulders (see paragraph 37). Your occupational health service provider should be able to help you identify employees who may be particularly susceptible to vibration injury (see Part 3).

Planning for risk control

118 The programme of action is an important stage in the risk management/control process. When exposures are likely to be at or above the EAV, a programme of organisational and technical measures should include:

(a) Identify the significant sources of vibration;
(b) Prioritise them as contributors to risk (exposure);
(c) Identify and evaluate solutions in terms of practicability and cost;
(d) Plan the introduction of reasonably practicable controls, with timescales;
(e) Plan the introduction of health surveillance if exposures are still likely to exceed the EAV or people are at particular risk;
(f) Define management responsibilities and allocate resources to implement controls, evaluate them and monitor progress.

Control of vibration exposure and risk

Priorities

119 This section gives practical advice on ways to control vibration exposure with the subsections ordered by priority. It starts with elimination of vibration by replacing an industrial process and doing the job a different way, and runs through to the management of daily exposure time and keeping warm and dry. For the full hierarchy, see paragraph 91.

120 Although actions at the top of the hierarchy are likely to have most effect, it is stressed that a combination of measures from various points in the hierarchy are likely to be required to achieve adequate control. It is important to ensure that measures to eliminate or reduce vibration risk do not introduce other risks to health or safety.

Eliminate vibration exposure by changing the work processes

121 The most effective and reliable way of eliminating the risk from vibration is to design (or redesign) work processes so that employees are not exposed to vibration at all. Where large reductions in vibration exposures are required this approach is sometimes the only way of adequately controlling the vibration risk, and it will often prove cost-effective in the long term.

122 Re-engineering industrial processes often requires review of formal standards (such as production methods or finishes agreed with customers) before the required changes can be put in place.

123 Designers and managers should plan working methods to avoid exposing employees to vibration. For example, finishes should be specified that can be achieved without the use of powered hand tools. See Table 3 for more examples in several industry sectors of process changes that reduce vibration exposure.

124 Your trade association and other industry contacts, equipment suppliers and trade journals may all be able to help you identify industry standards. Where effective alternative working methods have been established elsewhere, these should be adopted where it is reasonably practicable to do so.

125 Your action plan should include systems for ensuring that designers and planners are aware of new developments and that they consider alternative designs and methods to:

(a) avoid (or minimise) the need for operations and equipment exposing workers to vibration;
(b) introduce vibration-reduced machines or processes;
(c) improve the ergonomic design of workplaces, equipment, working methods and tasks.

Reduce exposure by mechanisation

126 Mechanisation, the use of robotics, remote control or other forms of automation can eliminate or reduce exposure. For example:

(a) In the foundry industry, using manipulators and remote-control swing grinders allows more force to be applied during fettling than is possible with a hand-held grinder and productivity can be increased;
(b) In the amenity horticulture industry, using vehicle-mounted side-arm flails for hedge-cutting can eliminate the use of hedge trimmers.

127 Robot (or highly-automated) grinders and burning machines can be used in place of hand-held machines for the removal of casting feeder heads and other fettling operations.

Reduce exposure by good process control

128 Good process control is important for maintaining product quality, production efficiency and controlling vibration exposure. For example, improving the quality control of car-body panel pressing to keep the press-shop dies clean and in good order reduces the need for reworking with powered hand-held tools to remove blemishes in the product.

129 Minimising the need for remedial work often reduces the need to use powered hand tools and lowers overall production costs. For example, improving mould precision in concrete or metal casts can greatly reduce the need for chiselling, grinding, cutting or sanding of the final product.

Table 3 Examples of alternative work processes to eliminate or reduce exposure to vibration

Industry	Problem	Solution
Amenity horticulture	Use of power tools (eg hedge trimmers, chainsaws, strimmers and mowers) for park maintenance	Consider allowing more natural meadow, hedge and tree growth Select slow-growing/low-growing shrubs Use vehicle-mounted machinery such as a side-arm flail
Construction	Use of scabbling tools and needle scalers for architectural finishes	Specify architectural finishes and processes that don't require the use of powered hand tools (eg chemical retardants, shuttering)
	Cutting and patching of stone, wood or concrete products to fit using powered hand tools on site	Prefabricate components using factory-based machining
	Use of demolition hammers to break up large concrete blocks and walls	Split large blocks using hydraulic expanding devices inserted into pre-drilled holes (bursting) or use driven or remote control plant which can be fitted with nibblers and peckers
	De-scaling of steel structures after fabrication using pneumatic scaling tools	Use abrasive blasting or high-pressure water jetting instead of pneumatic scaling tools
Foundries	Hand finishing (fettling) of cast components	Design metal castings to minimise the need for remedial work, including design of moulds, selecting the most suitable materials and casting process
	Removal of large amounts of material from castings using powered hand tools	Use arc-air and other flame-cutting or gouging methods
Light and heavy fabrication	Remedial work with powered hand tools on components plasma cut from sheet or plate metal	Cut sheet and plate metal using laser profilers which give accurate cuts, produce minimal heat distortion and virtually eliminate edge burring
Light fabrication	Use of hand-held, hand-guided or hand-fed machines	Mechanise or automate processes
	Use of pneumatic riveting hammers	Change fabrication methods, eg use adhesives, welding, hydraulic squeezing etc
	Polishing of plated components	Use preliminary, chemical-polishing processes to minimise need for hand polishing
Light fabrication and foundries	Metal-removal or fettling using powered hand tools	Use milling, turning or other machining operations (it can be more economic, and less hazardous, to rough machine, rather than hand fettle, surfaces which can later be machine finished)
Utilities and construction	Use of hand-operated road breakers for cable laying, water and mains repairs and similar work	Use machine-mounted breakers, tampers, mobile road-cutting machines and/or trenching machines

Avoid high-vibration machines and accessories

130 After doing all that is reasonably practicable to replace or modify work processes, employees may still be exposed to vibration. If so, unnecessarily high vibration exposures should be avoided by careful selection of power tools and other equipment. This can be done by:

(a) reviewing the available vibration emission information for machines of a similar type and determining the range of vibration emission values that are declared for competing machines (see Appendix 5);
(b) deciding a maximum level of vibration emission for a machine class for future purchase or hire;
(c) asking suppliers to provide tools or consumables (such as grinding wheels) for trial by the prospective users;
(d) if there is doubt about the applicability of available vibration data, asking the supplier whether they are able to perform on-site measurement.

131 The efficiency of a power tool is important – a machine which takes a long time to do a job will not be popular, and could result in a higher vibration exposure than a more efficient tool with greater vibration emission. Machines may also be too powerful for the job, and this could also result in unnecessarily high vibration exposures.

132 Advances in material and manufacturing technology have brought about improved designs of hand-held and hand-guided machines, and lower levels of vibration emission; however, simply buying newer machines may not eliminate or minimise the vibration exposure. There may still be a residual risk from exposure to vibration which must be managed, and if the machine chosen is not suitable for the job, it could increase the risk (The Provision and Use of Work Equipment Regulations 1998[17] apply).

133 Machines must be:

(a) suitable for the work they are intended to do and for the conditions in which they will be used;
(b) used only for operations and in conditions for which they are suitable;
(c) selected to reduce the risk from vibration;
(d) used only by workers trained to use them safely;
(e) properly maintained (as necessary) throughout their working life to sustain minimum vibration.

134 Selection of machines for purchase or hire should include consideration of ergonomic factors such as:

(a) machine weight;
(b) machine efficiency and suitability for the task;
(c) handle design/comfort;
(d) grip and feed forces needed;
(e) ease of use/handling;
(f) warmth of hand grips;
(g) direction of exhausts away from hand-grip areas on compressed air tools;
(h) noise;
(i) dust.

135 Anyone supplying machines for use at work in Great Britain, whether new, second hand or hired, must comply with section 6 of the HSW Act. The general duty here for safety and health by design and construction, so far as is reasonably

practicable, extends to the provision of information, such as passing on the manufacturer's instructions. New machinery must also comply with the specific requirements of the Supply of Machinery (Safety) Regulations 2008, which require that risks from vibration are reduced to a minimum, and that information necessary to operate safely is provided, such as instructions. These must include warnings about residual risk due to any shortcomings of the protective measures adopted, indicating whether any particular training is required (see Appendix 5).

136 The selection of inserted tools and consumable components such as drill bits, grinding wheels, chisel bits and abrasive papers can have a significant impact on the efficiency of a machine. Suppliers should be able to advise on the appropriate consumable or inserted tool for the tasks being carried out.

Maintain machines and accessories

137 Power tools and other work equipment should be serviced and maintained in accordance with the manufacturer's maintenance schedules. In some cases, maintenance is essential to prevent unnecessarily high vibration levels and ensure efficient operation. This maintenance may include:

(a) keeping cutting tools sharp;
(b) dressing grinding wheels correctly;
(c) replacing worn parts;
(d) carrying out necessary balance checks, tensioning and other corrections;
(e) checking and replacing defective vibration dampers, bearings and gears;
(f) tuning and adjusting engines.

138 As inserted tools, consumables and other accessories reach the end of their working life, it is important that they are replaced with suitable products. The replacements should maintain the low-vibration performance of the overall machine and be at least as efficient as the component they replace.

139 Care should be taken when replacing components such as side-handles. These may modify the dynamic behaviour of the machine, and even handles marketed as 'vibration-isolating' can increase vibration exposures if they are poorly matched to the machine. It is advisable to replace components such as these with manufacturer-approved replacements.

Reduce the transmission of vibration into the hand

140 When the use of vibrating equipment and exposure to vibration is unavoidable, it is often possible to control the extent to which damaging vibration is transmitted to the hand by minimising grip and push (sometimes known as feed) forces.

141 As well as the vibration magnitude, the amount of vibration energy passing into the hand can depend on:

(a) the position of the hand on the machine, handle or workpiece;
(b) the forces applied by the hand in gripping, pushing, guiding and supporting the vibrating machine, handle or workpiece;
(c) ergonomic factors associated with machine use and the operator's posture.

142 Jigs and similar aids incorporating anti-vibration mounts can help avoid the need to grip vibrating surfaces. In some cases, the machine manufacturer may supply, or endorse the retrofitting of, anti-vibration handles to their product.

143 Wrapping rubber or other resilient materials around vibrating handles may reduce some vibration at high frequencies, and may improve comfort, but is unlikely to reduce significantly vibration at the frequencies which contribute most to exposure.

144 Gripping or pushing forces are necessary to support the machine or workpiece, to control or guide the machine, or to achieve high working rates. However, it is often found that the forces used are greater than those needed for efficient and safe use of the machine. The cause of these excessive forces may be incorrect equipment selection, inadequate maintenance, insufficient operator training or poor workstation design. It is important to remember that the greater the gripping or pushing forces exerted through the hand onto the vibrating surface, the more efficiently the vibration passes into the user's hand and arm. Improvements that may reduce unacceptably high gripping and pushing forces include:

(a) providing additional support where heavy workpieces are ground by hand at pedestal grinders (providing a support for the whole piece will mean that the worker needs only to guide it and hold it against the wheel, rather than support all the weight);
(b) using tension chains (counter-balancers) and manipulators to support vibrating machines such as heavy drills, grinders, nut runners, nailing guns and pneumatic chisels, so that the operator does not have to support the machine's weight;
(c) changing the texture and material of a grip surface so that the operator may be able to use a lighter grip force to hold and control the machine;
(d) ensuring grinding wheels are dressed to maintain concentricity and balance.

Reduce the durations of exposure (including job rotation)

145 When the vibration levels have been reduced so far as is reasonably practicable, further reduction in exposure can only be achieved by limiting the time for which employees are exposed to vibration. Limiting the duration is sometimes essential to keep exposures below the ELV.

146 Job rotation (sharing the work and the vibration exposure between several people) can be used to reduce exposure of some individuals, at the expense of increasing the exposure of other individuals. Job rotation is an inefficient way of reducing exposure. For example, if one job, completed by one person, results in one exposure at the ELV, using job rotation to achieve all exposures below the EAV would require job rotation for at least four people.

147 Effective supervision is required after introducing new working patterns to prevent, for example, old working practices reappearing with higher vibration exposures.

148 Various tool-timing devices are available which log the duration of machine use. These include in-line electrical and pneumatic timers or more sophisticated electronic and vibration-sensitive timers. If it helps you to do your risk assessment, a period of monitoring with these devices to understand how long employees use a particular machine in a typical day or week may be useful. However, once you have enough information on likely exposure, your focus should move to taking practical steps to reduce the exposure and risks.

149 Tool-timers have a limited role in helping you to comply with legal duties. There is no legal requirement under the Vibration Regulations for continual monitoring and recording of vibration exposure. Using log books and tool-timers, and continual monitoring, can distract you from your duties to eliminate or reduce vibration risks.

150 Employees who are paid according to piecework or payment-by-results schemes can be at increased risk. Not only is the period of exposure likely to be intensive and with fewer breaks, but also the rapid pace of work can result in employees applying higher levels of force to the task, increasing the risk of vibration-related ill health and musculoskeletal problems.

Keeping warm and dry

151 Low hand or body temperature increases the risk of finger blanching because of reduced blood circulation. Gloves and other warm clothing can help vibration-exposed workers maintain good circulation. More than one set may be required for each employee if the gloves or clothing are likely to become wet. Employees working in cold environments (outdoors or indoors) should have an adequate supply of warm, dry clothing.

152 Gloves and other clothing should be assessed for good fit and for effectiveness in keeping the hands and body warm and dry in the working environment. Gloves or other clothing provided should be selected to ensure that they do not stop employees working safely and do not present a risk of entanglement with moving parts of machinery.

153 Anti-vibration gloves cannot be relied upon to provide protection from vibration (see Appendix 4).

Other measures

154 As well as the range of actions you can take to reduce workers' exposures to vibration, there are other measures which, while not reducing the daily vibration exposure, are thought to reduce the risk. For example:

(a) Plan employees' work to avoid prolonged exposure. Breaks should be taken in long-duration tasks, as several shorter exposures with recovery periods are believed to be preferable to one long exposure.
(b) Keep indoor workplaces warm and dry.
(c) Provide screening or shelter for outdoor workers in cold, wet or windy conditions.
(d) Provide hot drinks and warm food to help maintain body temperature – particularly important in cold working environments.
(e) Encourage employees to maintain good circulation by avoiding long periods in one posture and to exercise and massage the fingers during breaks from work with vibrating equipment.
(f) Encourage employees to stop smoking, as this can lead to impairment of peripheral circulation.
(g) Provide a work system where grip and feed forces may be reduced to a minimum, taking into account the safe operation of the machine.

Information and training for operators and supervisors

155 The co-operation of the workforce is required to make control measures effective in controlling the risk from any remaining vibration exposure. It is important that operators and their supervisors receive information about the risks from vibration and that they receive the required instruction and training in the correct use and maintenance of the equipment they use. Employees have a duty to co-operate with their employer's action to comply with health and safety legislation.

Employees' safety representatives should be consulted about the planning and organisation of health and safety training (see paragraph 84 for more information).

156 Operators may need to be trained in working techniques, for example to help avoid excessive gripping, pushing and guiding forces and to ensure that machines are operated safely and with optimum efficiency. With some machines, the operator's hands must be in the correct position to avoid unnecessarily high vibration exposure. Many modern machines, such as breakers, achieve vibration control by introducing suspensions between the handle or the body and the mechanism of the machine. Low-vibration emissions will not be achieved unless the machines are operated correctly. The manufacturer or supplier should advise of any training requirements and may offer training for operators. Operators should also be trained to:

(a) use the lightest machine capable of doing the work safely and efficiently;
(b) rest the machine as much as possible on the material being worked, letting its weight provide the downward force;
(c) rest hand-held workpieces on any support provided;
(d) hold the machine or workpiece with a light but safe grip.

157 Adequate training and supervision will be required to ensure that workers are adopting the practices necessary to protect them against the risks of developing vibration-related disease. They should be encouraged to report any symptoms (such as numbness, tingling or whiteness of the fingers) which may be associated with exposure to vibration.

158 If employees are in a health surveillance scheme the importance of this should be explained and they should be assured that a suitably qualified person will inform them of any findings (see Part 3).

Consultation with workers' representatives

159 Employers are required by law to consult with employees and/or their representatives on the introduction of any measures at the workplace which might substantially affect employees' health and safety. This should encourage the co-operation of the operators and supervisors with the control measures in place. These discussions may also be helpful when making decisions on control measures and should help finalise the action plan. Employees should be involved in trials of alternative work processes for reduced vibration or of potential new machines and equipment. A partnership with the workforce when planning control measures will help to ensure that the employer's action plan is workable, that the employees understand it and that they co-operate with actions to control the risk to their health.

Obtaining competent advice and assistance

160 As an employer, you are responsible for controlling risk from vibration. This does not have to be done by one individual. For example, you might decide to employ external assistance to help with your vibration risk assessment and to use a competent person (who understands your business) to plan and carry out the necessary actions to control the risks from exposure to vibration. For advice on training and competence, see Appendix 7 and also webpages at www.hse.gov.uk/competence.

PART 3 Health surveillance

What is health surveillance?

161 Health surveillance is a programme of systematic health checks to identify early signs and symptoms of disease and to allow action to be taken to prevent its progression. It also checks the long-term effectiveness of control measures to safeguard the health of employees (including identifying and protecting people at increased risk).

162 In the case of HAV, one of the aims is to prevent employees developing hand-arm vibration syndrome associated with loss of hand function. It is possible that your employees who are exposed to vibration have mild symptoms of HAVS, the relevance of which they are not aware. Health surveillance can help them to recognise the significance of their symptoms.

What are the health effects of HAV?

163 Employees whose hands are regularly exposed to vibration may suffer from symptoms in the hands and arms. These symptoms include:

(a) Neurological – numbness and tingling in the fingers and a reduced sense of touch, temperature and pain perception; symptoms lasting more than 20 minutes after vibration exposure are likely to be pathological. These effects can make it difficult to feel, and to work with, small objects.
(b) Vascular – temporary reduction in blood circulation in the fingers with parts of the fingers becoming white (blanched). This effect is sometimes known as vibration white finger (VWF): the fingers feel numb when blanched. As blood circulation returns to normal, either by itself or after rewarming the fingers, they can be throbbing, red and painful. Although vibration causes VWF, it usually does not bring on the white finger attacks. The main trigger is exposure to the cold, eg being outdoors during winter, or by cooling in otherwise warm environments. Initially, the tips of the fingers are affected but symptoms usually get worse and the effects spread along the finger towards the palm with continuing exposure. The thumb may also be affected. Rarely, in very advanced cases, blood circulation may be permanently reduced in the affected fingers.
(c) Musculoskeletal – joint pain and stiffness in the hand and arm. Grip strength can be reduced.

The severity of HAVS is graded using the modified Stockholm Workshop scales (0–4). See Appendix 8 for more details.

164 An individual employee with HAVS may not experience the complete range of symptoms; for example, there may be numbness and tingling in the fingers without

there being blood circulation problems or the other way round. Neurological symptoms are likely to appear earlier.

165 Carpal tunnel syndrome, a disorder of the hand and arm which may involve tingling, numbness, pain and waking at night, can also be caused by exposure to vibration (v-CTS).

166 Employees suffering from HAVS can experience difficulty in carrying out tasks in the workplace involving fine or manipulative work and are less able to work in cold conditions. The disease may have an impact on earnings and on social and family life. Everyday tasks may become difficult, eg fastening small buttons on clothes. Attacks of white finger will take place not only at work but during other activities, especially if people get cold. Symptoms can affect a person's ability to hold machines, and employees can become a danger to themselves and their colleagues if they are likely to drop powered hand tools.

167 After symptoms first appear, generally the longer an employee is exposed to vibration, the worse the symptoms become, although the rate of deterioration will vary from person to person. How much symptoms may improve when people are no longer exposed to vibration is not well understood, but it is thought that numbness in the fingers does not improve after exposure stops. The effects on blood circulation may improve slowly after reducing or stopping vibration exposure, especially in younger people and when the disease has not yet reached an advanced stage. Smoking may undermine recovery in these individuals.

When must health surveillance be provided?

168 Appropriate health surveillance must be provided for vibration-exposed employees who:

(a) are likely to be regularly exposed at or above the EAV of 2.5 m/s^2 *A*(8);
(b) are likely to be exposed occasionally at or above the EAV and where the risk assessment identifies that the frequency and severity of exposure may pose a risk to health;
(c) are at particular risk even if exposure in the current job is below the EAV (see paragraph 37).

169 An effective health surveillance programme in the workplace will require co-operation from employees.

170 When you plan to introduce health surveillance, consult with your employees and their safety or employee representatives about what you are proposing to do and give them the opportunity to comment on your proposals. Employees need to be given information about the reasons for carrying out health surveillance and they need to understand their roles and responsibilities. There is a need to ensure that employees are aware that the results of their health surveillance, with respect to fitness for work, will be disclosed to the employer, but that no clinical information can be given to anyone without their consent.

171 When health surveillance is required, it should be carried out at least annually. Both initial (or baseline) assessment and periodic health surveillance are needed for HAVS. Early assessment of newly exposed employees is recommended, as susceptible individuals can develop symptoms in six months or less. Exposed employees should receive information on why and how to detect and report symptoms of HAVS (see regulation 8).

What should your health surveillance arrangements ensure?

172 Your arrangements should ensure that:

(a) any employee diagnosed with HAVS or v-CTS receives advice from an occupational health professional about their medical condition and the likelihood of disease progression with continued exposure;
(b) you receive advice about fitness for work with exposure to vibration even if the employee does not give consent for medical information to be disclosed;
(c) when appropriate, you receive advice about recommended restrictions that relate to the individual's exposure to vibration. This advice will vary according to the severity of the disease (see paragraphs 198–206 and Appendix 8).

The health surveillance programme

173 Health surveillance involves working through a number of tiers. This tiered system works as follows:

Tier 1: Initial assessment

174 Tier 1 is a short questionnaire (see Appendix 9) used as a first check for people moving into jobs involving exposure to vibration. Completed questionnaires should be sent in confidence to an occupational health professional because they contain information about the individual's medical history. The replies to the questionnaire will indicate whether they need to be referred to Tier 3 for a clinical assessment. You need to receive advice on fitness for work with vibration before the employee starts being exposed.

175 Individuals who suffer from certain disorders affecting the hand or arm, eg Raynaud's disease and CTS, should be identified during their initial assessment by questionnaire and, if necessary, clinical assessment. The health professional should advise you on the individual's fitness to work with vibration, and the employee of the possible increased risk of symptoms worsening from exposure to vibration. Some affected employees will need more frequent monitoring under the health surveillance programme.

Tier 2: Annual screening

176 Tier 2 is a short questionnaire (see Appendix 9) that you issue once a year to employees exposed to risks from vibration to check whether they need to be referred to Tier 3 for a clinical assessment.

177 If the employee answers 'yes' to any of the questions on the form, this does not mean that HAVS has been identified. Instead, the employee should be referred to an occupational health professional for more detailed clinical assessment, described here under Tier 3. In the absence of self-reported symptoms, there is no need for referral to Tier 3. This means that many employees will not need to attend an appointment with an occupational health professional. Completed questionnaires should be stored and kept 'in confidence'.

178 Employees should be given reminders about the nature of the symptoms and the need to report them. If an employee does not wish to disclose their symptoms to the responsible person, they should have the option to be referred to an occupational health professional. If symptoms of HAVS appear for the first time, or progress, employees should be encouraged to report them immediately and not to wait until the HAVS screening is carried out. Any reporting of symptoms triggers the need for referral for further assessment (Tiers 3 and 4).

Tier 3: Clinical assessment

179 This tier involves a clinical assessment by an occupational health professional. A questionnaire that asks about relevant symptoms and a targeted clinical examination are recommended. A detailed account of the procedures for assessment and diagnosis is found in Appendix 8 and an example of a Tier 3 questionnaire in Appendix 9.

180 Where the occupational health professional considers that exposure to vibration has resulted in HAVS or v-CTS, they should provide recommendations on fitness for work and give advice on the potential need to restrict exposure to vibration for that individual. You should assign the employee to alternative work where there is either restricted or no risk from further exposure to vibration, pending a formal diagnosis (see paragraphs 198–206). The employee should be referred for Tier 4 assessment as soon as possible. Where appropriate, you should review your risk assessment and the health of any other employee who has been similarly exposed.

Tier 4: Diagnosis

181 This tier involves a formal diagnosis and is carried out by a doctor with appropriate expertise. The doctor will confirm or amend any previous advice given, including fitness for work. You should act on any recommendations or restrictions made by the doctor. Depending on the advice given, it may be necessary to assign the employee to alternative work where there is either restricted or no risk from further exposure to vibration and review your risk assessment. An employee diagnosed with HAVS should be reassessed at regular intervals and may need additional assessments in order to monitor any progression of the disease.

182 Consultation with a specialist, eg neurophysiologist, could be required for diagnosis of v-CTS as investigation by nerve conduction tests may be required.

Tier 5: Optional testing

183 This is optional and involves referral of the employee to a specialist centre for further tests for HAVS as described in Appendix 8. The final diagnosis of HAVS still depends on the judgement of the doctor and cannot be based on these tests alone.

Responsible person

184 You have the option to appoint a responsible person to carry out the simple screening using the Tier 2 questionnaire as part of your health surveillance programme. This person:

(a) should be carefully selected to have experience of the working environment and be able to gain the confidence and co-operation of employees;
(b) need not be qualified but should have received training from an occupational health professional;
(c) should understand the health surveillance procedures, the process of referral to an occupational health professional, eg following a positive questionnaire response, and the need to treat information confidentially;
(d) should be able to describe to the employee the symptoms of HAVS but should not attempt to diagnose disease;
(e) should not make judgements about the cause of the symptoms if an employee discloses that they have symptoms.

How do I find someone who is competent?

185 You must make sure that occupational health professionals offering to carry out health surveillance have suitable knowledge, qualifications and training, are familiar with this guidance and will provide you with appropriate information to manage the risks. If there is a lack of competence, mistakes have the potential for serious consequences for you and your employees.

186 To undertake HAVS health surveillance at Tier 3, the occupational health professional should:

(a) understand the health effects of workplace vibration exposure and how it may present clinically;
(b) have the clinical skills to adequately assess the worker, provide advice and recommend Tier 4 assessment where appropriate.

187 Occupational health staff undertaking HAV health surveillance assessments should:

(a) be registered/licensed to undertake clinical practice as defined by their appropriate professional body (eg GMC for doctors, NMC for nurses);
(b) have a higher qualification in occupational health. Doctors should hold a diploma in occupational medicine as a minimum. Other occupational health staff should have a higher qualification in occupational health, eg diploma or degree;
(c) have successfully completed a Faculty of Occupational Medicine (FOM) approved HAV training course.

Where tests (eg Purdue peg board) are delegated to occupational health technicians (or equivalent), the supervising clinician must ensure they are competent to undertake the task and are sufficiently supervised. The supervising clinician retains overall responsibility for the assessment undertaken of the worker. This responsibility cannot be delegated to the technician.

What information will I receive and what do I need to do about the results of health surveillance?

188 An employee found to have HAVS should be informed of this by an occupational health professional. You can be told about an individual employee being diagnosed with HAVS as long as the employee gives their written consent. You may receive recommended restrictions that relate to the employee's job.

189 You should receive advice on fitness for work with exposure to vibration for each employee undergoing health surveillance. This will be entered in the health records that you keep.

190 If an occupational health professional advises you that an employee is not fit for work with vibration, consider assigning the employee to alternative work where there is either restricted or no risk from further exposure to vibration. If exposure is allowed to continue, the employee is at risk of developing disabling loss of hand function. See paragraphs 198–206 for further explanation of the issues concerning fitness for work.

191 If you are informed that an employee has been diagnosed with HAVS but is still fit for work with exposure to vibration, you must review your risk assessment and check that exposures to vibration are ALARP. See paragraphs 198–206 for more details of the actions required to protect the individual with vibration-related disease.

192 You should expect to be provided with anonymised information for groups of employees whenever this is feasible. In the case of large groups individual consent is not required, but where the group of employees is small, confidentiality will have to be addressed. You should use the information to assess the long-term adequacy of your vibration risk controls, for example by task or workshop. Employees should be made aware of this taking place. If the number of employees with HAVS has increased, or if the disease is progressing in those with HAVS, you need to review your risk assessment and action plan.

What type of records should I keep?

193 You should keep a health record for each individual for as long as they are under health surveillance, although you may wish to retain it for longer. It is advisable to offer individual employees a copy of their health records when they leave your employment, if your business should cease trading, or if the employee ceases to be exposed to vibration. The record should be kept up to date and should include:

(a) identification details of the employee;
(b) the employee's history of exposure to vibration;
(c) the outcome of previous health surveillance in terms of fitness for work: fit, not fit or fit with restrictions, and any restrictions required which will typically involve a reduction in vibration exposure.

194 The enforcing authority is entitled to ask to see your health records as part of their checks that you are complying with the Vibration Regulations.

195 Health records should not contain personal medical information. The occupational health professionals running your health surveillance programme will hold clinical data and documents relating to individuals; these are confidential medical records. Any additional information supplied by your occupational health provider should be kept as required by the Data Protection Act 2018.

RIDDOR reporting

196 All employers, the self-employed and people in control of work premises have duties under the Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (RIDDOR).[18] They must report accidents resulting in the death of any person, certain work-related injuries, cases of ill health and dangerous occurrences. HSE will pass details to the relevant enforcing authority. Reporting under RIDDOR does not suggest the acceptance of responsibility or liability; it is simply informing the enforcing authority that an incident has occurred. Under RIDDOR, it is an offence not to report. Employers and the self-employed must report certain occupational diseases, when diagnosed by a doctor. This includes:

(a) hand-arm vibration syndrome: where a person's work involves regular use of percussive or vibrating tools, or holding materials subject to percussive processes, or processes causing vibration;
(b) carpal tunnel syndrome: where the person's work involves regular use of percussive or vibrating tools.

You can find more information about reporting at www.hse.gov.uk/riddor.

Industrial Injuries Disablement Benefit scheme

197 It may be appropriate for you to advise your employee that HAVS and v-CTS are both prescribed diseases under the Industrial Injuries Disablement Benefit (IIDB) scheme. The doctor diagnosing HAVS and v-CTS should also advise this.

Management of the affected employee, including fitness for work

198 Any employee diagnosed as suffering from HAVS or v-CTS will need to receive advice from the occupational health professional about their medical condition and the likelihood of disease progression with continued exposure. You should receive advice about fitness to work with vibration and any restrictions required from a suitably qualified doctor. The advice will vary according to the severity of the disease. HAVS is classified according to severity, using the modified Stockholm Workshop scales (see Appendix 8, Table 8 for an explanation). There is no staging of severity for v-CTS.

199 When a new case of HAVS or v-CTS is diagnosed, you must review your risk assessment and check that exposures to vibration are ALARP. If an existing case is found to have progressed you should review your risk assessment and consider whether to restrict exposure. The occupational health professional will need to consider the susceptibility of the employee to vibration-related disease.

200 You should consider how reducing vibration exposure for the individual might reduce the likelihood of their vibration-related disease getting worse using the advice you are provided with. If the occupational health professional has advised you that the disease is progressing, or that the individual is susceptible, you will need to at least reduce their exposure to vibration to prevent further progression. Health surveillance for the individual may need to take place more frequently, depending on the advice of the occupational health professional, if there is concern about progression of the disease.

201 Continuing exposure is usually acceptable in early cases, including the lowest category of HAVS – stage 1. It may be possible to prevent employees with HAVS stage 1 from progressing to HAVS stage 2 but this can depend on the individual's susceptibility and whether exposure can be restricted. If an employee is diagnosed as having HAVS stage 2, the aim is to prevent HAVS stage 3 developing because this is a more severe form of the disease associated with significant loss of function and disability. At the onset of HAVS stage 2, there should be increased frequency of health surveillance of the individual as determined by the occupational health professional to detect any progression of symptoms.

202 HAVS stage 2 covers a broad range of symptoms including significant loss of function. Some optional tests (Tier 5) can help to assess whether late stage 2 has been reached. Tier 5 may also provide a second medical opinion and access to other specialised tests. A method for dividing HAVS stage 2 into early and late forms using the results from the Tier 5 tests and an assessment of symptoms is given in Appendix 8. The doctor will decide on the diagnosis and you should be advised whether the employee is fit to continue with exposure to vibration.

203 Management of existing cases of HAVS stage 2 and stage 3 is potentially different as more information may be available about the rate of progression over time. An employee who has been monitored under health surveillance for a long period of time and has shown no progression of symptoms, and who fully understands the risks involved in ongoing exposure, may be allowed to continue work with limited exposure under frequent health surveillance. To help the doctor consider appropriate fitness for work recommendations, it is often helpful to make sure they have access to employee job descriptions, risk assessments, control measures in place etc.

204 If v-CTS is diagnosed, you will need to receive advice on fitness for work with vibration from the occupational health professional. The employee may need to be removed from exposure to vibration. Recommendations for return to work with exposure to vibration following surgery should be made on an individual basis and the employee should be informed of the possible return of symptoms with continued exposure. More frequent health surveillance may be appropriate for a time.

205 When a recommendation is made that an employee is no longer fit for exposure to vibration, you have to decide on the appropriate action to take. Factors such as availability of other work with no exposure to vibration may play a part in this decision-making process.

206 A recommendation of not fit for work may need to be made on safety grounds. For example, losing control of a tool due to HAVS symptoms might increase the risk of accidental injury to the employee or their co-employees.

Appendix 1 Estimation of daily vibration exposure

1 The Vibration Regulations require assessment of employees' daily exposures, so that the necessary action to control the risk can be planned. It is not important to obtain a precise daily exposure (it will probably vary from day to day anyway). Enough information will be needed to establish whether it is likely that the EAV will be reached or exceeded and ensure that the ELV is not exceeded. It will usually be possible to do this without having to make vibration measurements in a workplace.

2 The Vibration Regulations (Schedule 1) use the definition of daily vibration exposure given in BS EN ISO 5349-1:2001. Daily exposures are expressed as eight-hour energy equivalent vibration magnitudes (*A*(8) values). Exposures expressed in this way can be compared with one another and with the EAV and the ELV in the Vibration Regulations. The *A*(8) value is the vibration magnitude (frequency-weighted root-mean-square (rms) acceleration in metres-per-second-squared (m/s^2)) which, if maintained constant for a period of eight hours, would be equivalent, in energy terms, to the actual vibration for the actual exposure time.

3 Additional, more detailed, guidance on vibration exposure evaluation (including practical information on the measurement of vibration) is given in BS EN ISO 5349-2.[19]

Information needed to estimate daily vibration exposure

Vibration magnitude

4 The vibration magnitude produced in many work processes can be highly variable. It can be affected by the condition of the machine, the material being worked, the operator's technique and how it was measured. It is therefore necessary to find a value (or range of values) to represent the magnitude of vibration to which the hand is exposed during the work process.

5 Vibration magnitudes used to estimate vibration exposures should have been measured on machines similar to those being assessed, and in broadly similar operating conditions. Ideally, the vibration information used will be for the specific make and model of machine. However, if this is not available, data for a similar machine can be used as a starting point (see Appendix 3), replacing this with more specific information, should the initial information be found unsuitable. The suitability of vibration data for assessment of exposure can be established by consideration of factors including:

(a) the range in vibration emissions for other models of the type of machine and the likelihood that the machine being assessed could be very different to the average;
(b) the power source (eg pneumatic, electric);
(c) the class of machine (eg power rating, operating speed, size or weight);
(d) any vibration-reducing features (eg suspended handles);
(e) the task for which the machine was used when the vibration was measured (eg breaking concrete, grinding steel);

(f) the material being worked;
(g) accessories or inserted tools (eg type of chisel or grinding disc).

Daily exposure duration

6 Before the exposure can be calculated, the total daily duration of exposure to the vibration from a machine or process must be obtained. It is important to remember that this is the actual time for which the hands are exposed to the measured magnitude of vibration from the hand-held, hand-guided or hand-fed machines.

7 The time that the machine is held with the power on is sometimes called the 'contact time' or 'trigger time' and is often over-estimated by machine operators.

8 For processes where the machine is operated for long periods in the day, the daily exposure duration can be estimated by observing the work during a representative part of the working day and noting how much of the time the machine is operating. A stopwatch, video recording or on-tool timing device can be useful for this.

9 If the vibration is intermittent, the total exposure duration can be more difficult to estimate. However, for regular repetitive operations (such as in the manufacturing or processing of identical components) information usually exists on the number of such operations occurring in a day. If an average duration for a single operation is established by observation, the total daily duration can then be estimated.

10 For some jobs (such as jobbing work and maintenance), the work and the vibration exposure duration will vary from day to day, so there is no typical daily vibration exposure duration. For people in these jobs, the objective is to establish the likelihood of exposures reaching or exceeding the EAV and determining what activities cause those exposures. Observations need to be made of the range of activities undertaken, possibly over several days. From these observations the likely daily exposures for a nominal day or days should be estimated. You should be cautious when estimating likely daily vibration exposure so that exposure is not underestimated and you can be confident that your actions to control the risk will be effective.

Matching the magnitude to the duration

11 Caution can be required when using vibration magnitude data measured by someone else. For example, for a machine causing short bursts of vibration, such as a hammer drill, it is important to know if the measurements are made during drilling only or over a period including pauses (ie periods without vibration) between drilling. The vibration magnitudes measured in the two different ways are likely to be different. However, for machines operated for long periods, where contact with the handles is more or less continuous, such as a lawnmower, the measurement is unlikely to be affected by breaks in vibration (see BS EN ISO 5349-2).

12 If operations lead to short bursts of vibration (eg work with riveting hammers or impact wrenches), rms vibration values can be obtained by measurements made over periods of, for example, 60 seconds. If during this time five short riveting operations take place, then you can use a notional exposure duration of 12 seconds per rivet (ie 60 divided by 5 is 12) in determining a daily exposure with that measured vibration magnitude. If measurements were made only during the short periods when the machine was operating, the measured magnitude would of course be greater and the exposure duration would be the true trigger time. It is difficult to perform shorter trigger time measurement of this type and the exposure time is also more difficult to assess accurately (see BS EN ISO 5349-2).

Uncertainty

13 Whether you have obtained your vibration magnitude through measurement in the workplace or from other information, this value, your estimate of exposure duration, and the daily exposure you derive from them, will be subject to uncertainty. Research[20] conducted for HSE has shown that errors arising from the process of sampling and measuring vibration magnitude, and estimating exposure duration, can result in an uncertainty in the $A(8)$ value of at least ±20%. To comply with the Vibration Regulations you do not need to produce exposure values with high precision, but if your estimated exposures are close to the EAV or ELV, then you should assume that it is likely that they will be exceeded and the employer should take the appropriate action to reduce the exposure, control the risk, start health surveillance and provide training.

Vibration exposure calculations

Daily exposure

14 Exposure to HAV should be evaluated in accordance with BS EN ISO 5349-1:2001.

15 The vibration exposure for the daily use of a process or machine is calculated from a magnitude and a duration, using:

$$A(8) = a_{hv}\sqrt{\frac{T}{T_0}} \qquad \textbf{Equation 1}$$

where $A(8)$ is the daily vibration exposure, a_{hv} is the vibration magnitude (in m/s^2), T is the daily duration (in hours) of exposure to the vibration magnitude a_{hv} and T_0 is the reference duration of 8 hours. (Note that, because of the square-root term, changes and uncertainties in exposure duration have a smaller effect on the $A(8)$ value than similar changes and uncertainties in vibration magnitude.)

Partial vibration exposures

16 If a worker is exposed to vibration from more than one source of vibration (perhaps because they use two or more different machines or processes during the day) then partial vibration exposure values are obtained from the magnitude and duration for each source. These values are then combined to give the overall daily exposure value, $A(8)$, for that person, using:

$$A(8) = \sqrt{A_1(8)^2 + A_2(8)^2 + A_3(8)^2 + ...} \qquad \textbf{Equation 2}$$

where $A_1(8)$, $A_2(8)$, $A_3(8)$ etc are the partial vibration exposure values for the different vibration sources, each calculated using Equation 1.

17 Partial exposure values will help set priorities when developing the action plan – the largest partial exposures contribute most to the overall value of $A(8)$ and should be given priority for reduction.

Time to reach exposure action and limit values

18 Vibration magnitudes can also be used to calculate the time required to reach the exposure action value (T_{EAV}) and time required to reach the exposure limit value (T_{ELV}) using, respectively:

$$T_{EAV} = \left(\frac{EAV}{a_{hv}}\right)^2 T_0$$ **Equation 3**

Where *EAV* = 2.5 m/s² *A*(8) and

$$T_{ELV} = \left(\frac{ELV}{a_{hv}}\right)^2 T_0$$ **Equation 4**

Where *ELV* = 5 m/s² *A*(8)

The exposure points system

19 Assessment and subsequent management of exposures to multiple sources of vibration within a day can be simplified by using the exposure points system. Unlike the process of adding *A*(8) values (see Equation 2), exposure points can be added using simple arithmetic. The number of exposure points per hour of use (or any convenient period of time) can be established for a type of machine or work process from its vibration magnitude. This provides employers with a simple method of recording and controlling vibration exposures.

20 The number of exposure points, *n*, is defined by:

$$n = \left(\frac{a_{hv}}{EAV}\right)^2 \times \frac{T}{T_0} \times 100$$ **Equation 5**

where a_{hv} is the vibration magnitude in m/s², *T* (in hours) is the exposure time and T_0 is the reference duration of 8 hours.

21 The *A*(8) value is related to the number of exposure points, *n*, by:

$$A(8) = EAV \times \sqrt{\frac{n}{100}}$$ **Equation 6**

22 The exposure scores corresponding to the EAV and ELV are then:

(a) exposure action value (2.5 m/s² *A*(8)) = 100 points;
(b) exposure limit value (5 m/s² *A*(8)) = 400 points.

23 For any particular machine or process, the number of exposure points accumulated in an hour (n_{1h}) can be obtained from the vibration magnitude using:

$$n_{1h} = 2\, a_{hv}^2$$ **Equation 7**

The HSE ready-reckoner

24 Table 4 is a 'ready-reckoner' for calculating daily vibration exposure from vibration magnitude and exposure time information. The ready-reckoner covers a range of vibration magnitudes from 1 to 40 m/s² and exposure times from 5 minutes to 6 hours.

25 The exposure values in Table 4 are given as points rather than m/s² *A*(8) values. You may find the exposure points system easier to work with than *A*(8) values:

(a) exposure points change simply with time: twice the exposure time, twice the exposure points;
(b) exposure points can be added together, for example, where a worker is exposed to two or more different sources of vibration in a day;
(c) the EAV (2.5 m/s² *A*(8)) is equal to 100 points;
(d) the ELV (5.0 m/s² *A*(8)) is equal to 400 points.

26 The cells in Table 4 are colour-coded with:

(a) red for exposures above the ELV;
(b) green for exposures below the EAV;
(c) yellow for exposures between the two.

Table 4 Ready-reckoner for vibration exposure points

Key
- Above ELV
- Likely to be above ELV
- Above EAV
- Likely to be at or above EAV
- Below EAV

Vibration magnitude, a_{elv} (m/s²)	5 min	15 min	30 min	1 h	1 h 30 min	2 h	3 h	4 h	5 h	6 h
40	265	800								
30	150	450	900							
25	105	315	825	1250						
20	67	200	400	800	1200					
19	60	180	360	720	1100	1450				
18	54	160	325	650	970	1300				
17	48	145	290	580	865	1150				
16	43	130	255	510	770	1000				
15	38	115	225	450	675	900	1350			
14	33	98	195	390	590	785	1200			
13	28	85	170	340	505	675	1000	1350		
12	24	72	145	290	430	575	885	1150	1450	
11	20	61	120	240	365	485	725	970	1200	1450
10	17	50	100	200	300	400	600	800	1000	1200
9	14	41	81	160	245	325	485	660	810	970
8	11	32	64	130	190	255	385	510	640	770
7	8	25	49	98	145	195	295	390	490	500
6	6	18	36	72	110	145	215	290	360	455
5.5	5	15	31	61	91	120	180	240	305	365
5	4	13	25	50	75	100	150	200	250	300
4.5	3	10	21	41	61	81	120	160	205	245
4	3	8	16	32	48	64	96	130	160	190
3.5	2	6	13	25	37	49	74	98	125	145
3	2	5	9	18	27	36	54	72	90	110
2.5	1	3	6	13	19	25	38	50	63	75
2	1	2	4	8	12	16	24	32	40	48
1.5	0	1	2	5	7	9	14	18	23	27
1	0	1	1	2	3	4	6	8	10	12

Exposure time, *T*

27 Two further colours have been included to account for the uncertainty introduced by estimating exposures (see Appendix 1 paragraph 13):

(a) light green representing exposures (between 64 and 100 points) which should be considered as likely to be at or above the EAV;
(b) orange representing exposures (between 255 and 400 points) which should be considered as likely to be above the ELV.

28 If your exposure time does not appear on Table 4, you can add points from different columns. For example: for 1 hour and 15 minutes of exposure, add values in the 1-hour and the 15-minute columns; for 8 hours' exposure, double the 4-hour exposure points values.

Table 5 Using the exposure points ready-reckoner

Key

- Above ELV
- Likely to be above ELV
- Above EAV
- Likely to be at or above EAV
- Below EAV

Vibration magnitude, a_{elv} (m/s²)	5 min	15 min	30 min	1 h	1 h 30 min	2 h	3 h	4 h	5 h	6 h
40	265	800								
30	150	450	900							
25	105	315	825	1250						
20	67	200	400	800	1200					
19	60	180	360	720	1100	1450				
18	54	160	325	650	970	1300				
17	48	145	290	580	865	1150				
16	43	130	255	510	770	1000				
15	38	115	225	450	675	900	1350			
14	33	98	195	390	590	785	1200			
13	28	85	170	340	505	675	1000	1350		
12	24	72	145	290	430	575	885	1150	1450	
11	20	61	120	240	365	485	725	970	1200	1450
10	17	50	100	200	300	400	600	800	1000	1200
9	14	41	81	160	245	325	485	660	810	970
8	11	32	64	130	190	255	385	510	640	770
7	8	25	49	98	145	195	295	390	490	500
6	6	18	36	72	110	145	215	290	360	455
5.5	5	15	31	61	91	120	180	240	305	365
5	4	13	25	50	75	100	150	200	250	300
4.5	3	10	21	41	61	81	120	160	205	245
4	3	8	16	32	48	64	96	130	160	190
3.5	2	6	13	25	37	49	74	98	125	145
3	2	5	9	18	27	36	54	72	90	110
2.5	1	3	6	13	19	25	38	50	63	75
2	1	2	4	8	12	16	24	32	40	48
1.5	0	1	2	5	7	9	14	18	23	27
1	0	1	1	2	3	4	6	8	10	12

Exposure time, *T*

Using the exposure points ready-reckoner

1 Find the vibration magnitude (level) for the machine or process concerned (or the nearest value) on the grey scale on the left of the table.

2 Find the exposure time (or the nearest value) on the grey scale across the bottom of the table.

3 Find the value in the table that lines up with the magnitude and time. Table 5 shows how it works for a magnitude of 5 m/s² and an exposure time of 3 hours: in this case the exposure corresponds to 150 points.

4 Compare the points value with the exposure action and limit values (100 and 400 points respectively). In this example, the score of 150 points lies above the EAV. The colour of the cell containing the exposure points value tells you whether the exposure exceeds, or is likely to exceed, the exposure action or limit value.

Partial vibration exposures

29 Where a person is exposed to more than one source of vibration (perhaps because they use two or more different machines or processes during the day) this will result in two or more partial vibration exposure values. These partial exposures can be added together using exposure points to give the overall daily exposure value for that employee.

30 The partial exposures can help you to decide the priorities in your action plan for minimising vibration exposure, ie the machine and processes which provide the largest contributions to a person's overall daily exposure are those which should be given the highest priority for control.

Example: Use of partial vibration exposure

A heavy fabrication company has a regular contract to refit and paint steel barges. They use a vacuum-blasting system to strip paint and corrosion from the hulls. But this does not reach into all of the corners so they must use needle scalers. They also clean and dress small areas with angle grinders prior to carrying out weld repairs before repainting. They have a workforce of painters and welders.

The company has its own needle scalers and angle grinders which have served it well for these tasks. The tools are well maintained and the workforce are trained in correct use. The needle scalers have a vibration magnitude of about 12 m/s^2 and the angle grinders 8 m/s^2. They estimate daily use of about three hours for the angle grinders and 30 minutes for the needle scalers.

Having succeeded in eliminating a lot of vibration by introducing the vacuum-blasting system, the company uses the ready-reckoner to review and further manage vibration exposure. The company is considering getting the welders to do all the needle scaling and weld preparation work and the painters to do the vacuum-blasting and to paint. The daily vibration exposure for the welders would therefore comprise two partial exposures:

Angle grinder (8 m/s^2 for 3 hours):	385 points
Needle scaler (12 m/s^2 for 0.5 hour):	145 points
Total vibration exposure:	**530 points**

With this approach the ELV (400 points) would be exceeded and the company sets about planning the work in another way to ensure the welders' exposure is reduced, at least, to below the ELV and to as low as is reasonably practicable.

Although the needle scalers have a higher vibration level than the angle grinders, the use of the angle grinders accounts for the greater proportion of the welders' vibration exposure and is therefore a higher priority for urgent attention than the use of the needle scalers.

The partial exposure from use of the angle grinder is close to 400 exposure points, and it is likely that the ELV will be exceeded by this work alone. The company introduces a job rotation system. It trains some of its painters as welders' mates so that they are able to use angle grinders. This reduces daily use of the angle grinders by any employee to 1.5 hours in either a morning or an afternoon (but not both). The actual use of the angle grinders is then likely to be up to about 1.5 hours per day. Summing the points for 8 m/s^2 for 1 hour (130 points) and for 30 minutes (64 points) gives an exposure of 194 points and is well below the limit value.

The exposure from use of the needle scaler alone is greater than the EAV (100 points) and must also be reduced to the lowest level reasonably practicable. A reduced vibration model is hired with a vibration emission of about 7 m/s^2. This gives a partial exposure of only 49 points which by itself is below the EAV.

Because employees who use powered hand tools are regularly and frequently exposed above the EAV, a health surveillance scheme is introduced for them.

The planned controls of exposure to vibration – a maximum of 1.5 hours on the angle grinder and up to 0.5 hour on the needle scaler – should achieve maximum exposures of each employee of (from Table 4):

Angle grinder (8 m/s^2 for 1.5 hours):	194 points
Needle scaler (7 m/s^2 for 0.5 hour):	49 points
Total vibration exposure:	**243 points**

If all of the painters are trained to use the angle grinders and needle scalers, with careful management it will be possible to share work with the welders and halve the amount of hand-arm vibration exposure. This means the angle grinder work can be reduced to about 45 minutes and neither welders nor painters will need to use both a needle gun and an angle grinder on the same day. Exposure can therefore be further reduced. Using Table 4:

Angle grinder (8 m/s^2 for 30 minutes):	64 points
Angle grinder (8 m/s^2 for 15 minutes):	32 points
Total vibration exposure:	**96 points** on days when a grinder is used.
Total vibration exposure:	**49 points** on days when a needle gun is used.

The planned work will result in vibration exposure likely to be below the EAV on days when a needle gun is used and at or above the EAV but below the ELV on days when a grinder is used.

HSE's hand-arm vibration exposure calculator

31 HSE's exposure calculator for HAV is a popular tool for calculating daily exposures quickly and easily. The calculator is shown in Figure 1 and is available in the hand-arm vibration section of the HSE website at www.hse.gov.uk/vibration.

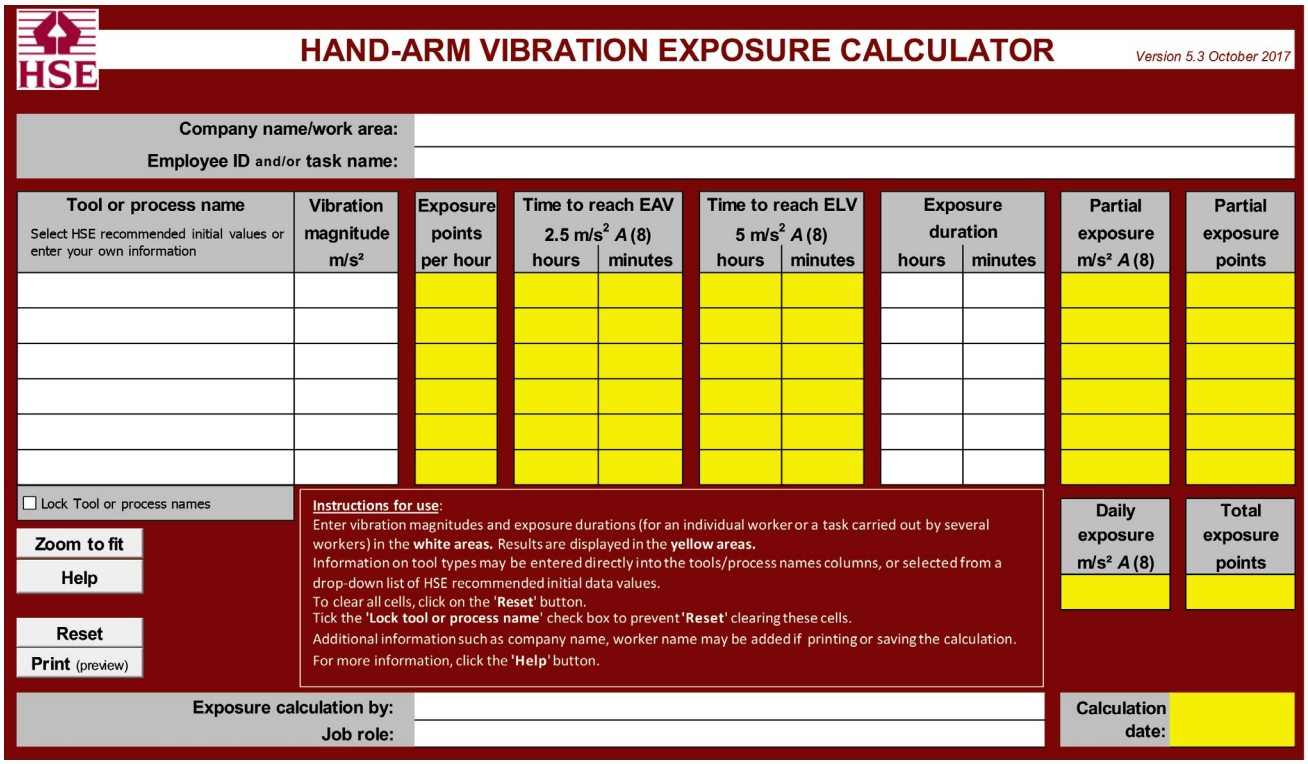


Figure 1 HSE vibration exposure calculator

Using the calculator

1 The calculator is a spreadsheet file (Microsoft Excel) which may be downloaded and saved on your computer.

2 Click on the white areas and enter a representative vibration magnitude (in m/s^2) and an exposure duration (in hours and/or minutes). You can do this for up to six different machines or processes. Information on tool types may be entered directly into the tools/process names columns, or selected from a drop-down list of common tools with HSE's indicative vibration magnitudes data.

3 When you have entered all the numbers, press the ENTER key, or click on a different cell. The following values will then be calculated and displayed in the yellow cells on the right:

Partial exposure (shown in both m/s^2 $A(8)$ and exposure points) for each tool or process, as calculated from the **vibration magnitude** and the **exposure duration**.

Daily exposure, also in m/s^2 $A(8)$ and exposure points, as calculated from the **partial exposures**.

4 In addition to the partial and total exposure values, the calculator also uses the vibration magnitudes to produce the following values:

Exposure points per hour. The number of exposure points for every hour of exposure time for the individual machine or process.

Time to reach EAV (exposure action value). This is the total exposure time required for the individual machine or process, before the EAV (2.5 m/s^2 *A*(8) or 100 points) is reached.

Time to reach ELV (exposure limit value). This is the total exposure time required for the individual machine or process, before the ELV (5 m/s^2 *A*(8) or 400 points) is reached.

5 Figure 2 shows the calculator in use. In this example, an operator uses three machines during a working day. The vibration magnitudes are 10, 6 and 3.5 m/s^2 and the total exposure times are 15, 30 and 90 minutes respectively. These values have been typed into the white cells (you can use hours, minutes or a combination of the two for the exposure duration). The results (in the yellow cells) show the partial exposure values for the three machines and the total exposure which is 2.8 m/s^2 *A*(8) or 123 points. Since the result is above the exposure action value a warning is displayed below the daily vibration exposure values.

6 The cells can be cleared for another calculation by clicking on the Reset button in the bottom left-hand corner.

Note: When you open the spreadsheet you may see a Microsoft Excel message asking you to decide whether to enable or disable macros. If your system settings allow it, you should enable macros. If not, the Reset button will not work. However, the white cells can still be cleared by deleting the contents manually.

HSE

HAND-ARM VIBRATION EXPOSURE CALCULATOR *Version 5.3 October 2017*

Company name/work area:

Employee ID and/or task name:

Tool or process name Select HSE recommended initial values or enter your own information	Vibration magnitude m/s²	Exposure points per hour	Time to reach EAV 2.5 m/s² A (8) hours	Time to reach EAV 2.5 m/s² A (8) minutes	Time to reach ELV 5 m/s² A (8) hours	Time to reach ELV 5 m/s² A (8) minutes	Exposure duration hours	Exposure duration minutes	Partial exposure m/s² A (8)	Partial exposure points
Tool or process 1	10	200		30	2			15	1.8	50
Tool or process 2	6	72	1	23	5	33	0.5		1.5	36
Tool or process 3	3.5	25	4	5	16	20	1	30	1.5	37

☐ Lock Tool or process names

Zoom to fit

Help

Reset

Print (preview)

Instructions for use:
Enter vibration magnitudes and exposure durations (for an individual worker or a task carried out by several workers) in the **white areas.** Results are displayed in the **yellow areas.**
Information on tool types may be entered directly into the tools/process names columns, or selected from a drop-down list of HSE recommended initial data values.
To clear all cells, click on the **'Reset'** button.
Tick the **'Lock tool or process name'** check box to prevent **'Reset'** clearing these cells.
Additional information such as company name, worker name may be added if printing or saving the calculation.
For more information, click the **'Help'** button.

Daily exposure m/s² A (8)	Total exposure points
2.8	123

WARNING: Exposure at or above 2.5m/s²A(8) EAV (100 points)

Exposure calculation by:

Job role:

Calculation date: 24 Nov 2017

Figure 2 The calculator in use

Appendix 2 Vibration measurement and instrumentation

1 You should take measurements where it is not otherwise possible to adequately assess the exposure and establish whether the EAV is likely to be reached or exceeded or the ELV is likely to be exceeded. This appendix explains how to measure the vibration magnitude.

What is measured?

2 The vibration magnitude (level) is represented by the frequency-weighted rms acceleration in m/s^2 of the surface of the tool, handle or workpiece in contact with the hand.

Frequency weighting

3 The risk to health from vibration is affected by the frequency content of the vibration. When vibration is measured in accordance with BS EN ISO 5349-1 it is measured over a frequency range from around 5–1250 Hz. Lower frequencies are given greater 'weight' in the measurement in a process called frequency weighting. Vibration meters intended for HAV measurement are equipped with a frequency-weighting filter that modifies their sensitivity to vibration at different frequencies.

Averaging

4 During a vibration measurement, the rms average value of the frequency-weighted acceleration is determined. It is important that the measurement duration is long enough to allow a representative average value to be obtained.

5 Measurements should be made to produce vibration values that represent the vibration for that tool or process throughout the operator's daily working period. It is therefore important that the operating conditions and measurement periods etc are selected to achieve this.

Measurement positions and directions

6 At each hand position on the tool, handle, workpiece etc the vibration is measured in three separate directions (known as the *x*-, *y*- and *z*-axes) at right angles to one another (see Figure 3). It is preferable to measure in all three directions at the same time.

7 For exposure evaluation, the three frequency-weighted rms acceleration values (a_{hwx}, a_{hwy} and a_{hwz}) are combined to give an overall frequency-weighted vibration magnitude, a_{hv}, using:

$$a_{hv} = \sqrt{a_{hwx}^2 + a_{hwy}^2 + a_{hwz}^2}$$ **Equation 8**

8 Here a_{hv} is the vibration total value, sometimes referred to as the root-sum-of-squares or the vector sum (see Figure 4). This value (at the hand position with the greatest vibration) is used to calculate the daily vibration exposure ($A(8)$ value) of the worker for comparison with the EAV and ELV.

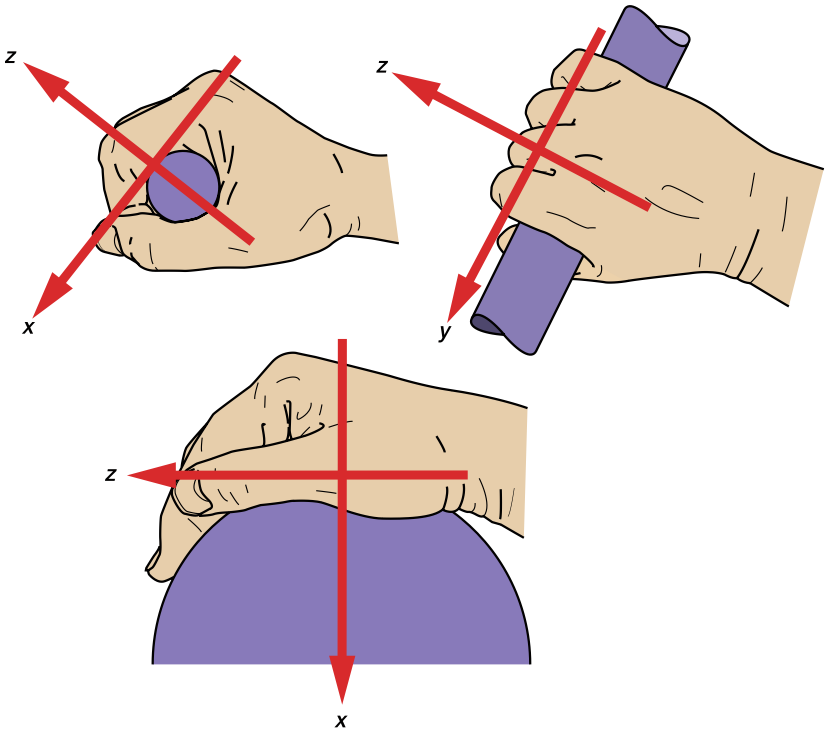


Figure 3 Directions of vibration measurement

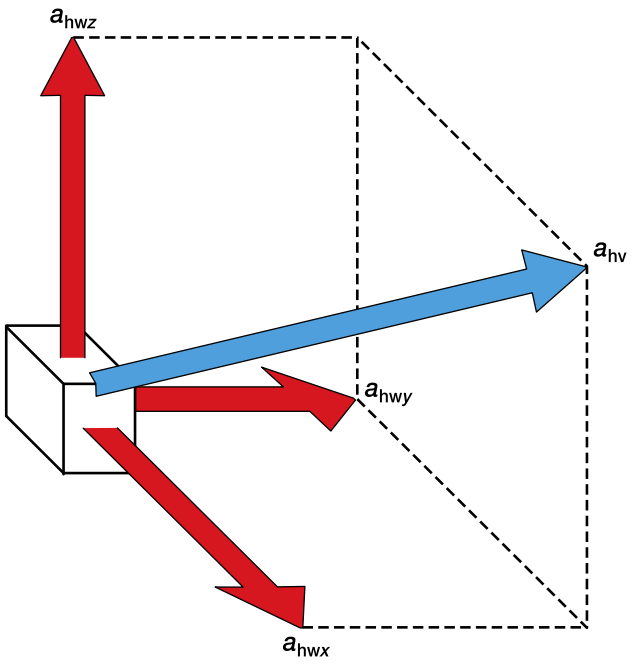


Figure 4 The vibration total value a_{hv}

Instruments for vibration measurement

9 Vibration meters and other items of measuring equipment should meet the correct specification for the measurement of hand-transmitted vibration given in BS EN ISO 8041.[21] Accelerometers (vibration transducers) and the accessories and methods for mounting them should be carefully selected; BS EN ISO 5349-2 contains useful guidance. Suppliers of vibration-measuring instruments should be able to advise on the selection of equipment suitable for the purpose.

How many measurements do I need to make?

10 A single measurement for a machine, an operator and a task provides limited information on vibration risk. This is because vibration magnitudes vary due to factors such as changes in forces, posture and techniques adopted by the operator as well as variation in materials and product. When making measurements you should plan to measure several operators, each working across a range of common operating conditions. This will help you establish the likely range in vibration emissions for a particular machine.

11 You will usually need to measure the vibration from examples of each of the makes and models of a particular machine type in use. The data should be analysed to find out if the vibration is significantly different for different makes and models. This will help you to:

(a) estimate exposures;
(b) identify the lower vibration models that should be preferred when the current machine comes up for replacement (or sooner if the risk is high); and may also
(c) identify particular operators and operating techniques that achieve consistently higher or lower vibration emissions.

12 You should analyse the measurements to establish a magnitude that represents the vibration of the machine. The mean plus one standard deviation or the upper quartile of the range of vibration measurements is usually sufficient when operators work on a wide range of tasks or products. You may need to use a vibration value that is representative of a specific task if you have employees who specialise in a particular product or task that is known to produce high vibration.

Appendix 3 Sources of vibration magnitude data

Selecting suitable vibration magnitude data

1 You should be cautious when identifying vibration magnitude data from which to estimate employee vibration exposures. You need to be careful to select a value that is representative of your work activities and will not produce an underestimate of vibration exposures. Vibration magnitudes associated with machines have changed in recent years (up in some cases, down in others) and, as far as possible, you should try to obtain up-to-date information. Vibration data is collected for many purposes and is not always suitable for use in estimating daily vibration exposures. Vibration data that may not represent the work you are doing includes data measured during non-working conditions such as idling; data used as part of maintenance checks; and data for comparing vibration emissions collected under tightly controlled non-working conditions.

2 You can increase your confidence in the quality or relevance of available vibration magnitude information by comparing data from at least two sources and seeking an explanation of any inconsistent vibration magnitudes. Data based on several models of a machine type may be more robust than data for an individual machine model. However, if data from several sources shows that the vibration of a particular model of machine is lower than is generally expected for machines of the same type, using that lower vibration model may reduce vibration exposures.

3 Many organisations hold information on measured vibration magnitudes, including manufacturers of work equipment, employers, trade associations, government bodies and consultants. Vibration data is available through technical and scientific publications and from online databases. You may be able to find relevant vibration information from others who have experience with the work processes and machines you use. You are likely to be able to find relevant vibration information for at least your initial assessment of vibration exposures without the need to make measurements yourself.

Vibration magnitudes measured for HSE

4 Table 6 contains a summary of vibration magnitudes of some common machines measured for HSE. The ‘tool type’, ‘tool characteristic, inserted tool, size, process’ and ‘notes’ should be used to check that there is a close match between your machine and the machine for which vibration data is provided.

Making an initial estimate of vibration exposure

5 You can use the ‘recommended initial value’ vibration magnitudes from Table 6 in combination with your observations of durations of exposure (trigger times) to make an initial estimate of daily vibration exposures. In many cases, this will be sufficient for you to determine your duties under the regulations and to review your control measures and revise them as necessary. The ‘recommended

initial value' is a vibration magnitude that is in the upper part of the range of vibration emissions during normal use of many models of the machine type. The actual vibration exposures may be lower than your estimates. However, vibration magnitudes can be higher than the 'recommended initial value' and you should make allowance for this. For example, if your estimated exposures are approaching the EAV you should assume that the EAV is likely to be exceeded (see Appendix 1 paragraph 13 for further information).

Reducing vibration exposure by choosing lower-vibration models of machine

6 For many machines, there is scope for reducing vibration exposures by avoiding high-vibration models of a machine type. There will always be some range in the vibration magnitudes due to differences in the work activity, the operators' techniques, and the condition of the tool etc. The greater the difference between the 'range-lower' and 'range-upper' values in Table 6, the higher the likelihood that there are clear differences between the vibration hazard of competing models of a machine type. The wider the range, the more likely it is that there is scope for you to reduce vibration exposure by using vibration magnitudes to choose between models of a tool type; for example, using vibration data for real use from reliable sources. Selection on the basis of vibration should be made from a shortlist of tools that have already been shown to be well suited to the work.

Table 6 A summary of vibration magnitudes of some common machines

Industry	Tool type	Tool characteristic, inserted tool, size, process	Notes	Range-lower (10th percentile) (m/s^2)	Range-upper (90th percentile) (m/s^2)	Recommended initial value (75th percentile) (m/s^2)
General	Drills	Standard drill bit	Vibration values can vary across the many sub-categories (eg small to large) and different materials being worked. Larger drills tend to give higher vibration values. Maintaining sharp drill bits is important	2	5	5
General	Drills	Hole saw		4	12	10
General	Drills – Core	78–107 mm	Can give very high vibrations if operators push too hard. Maintaining sharp drill bits is important	6	8	8
General	Drills – Impact	5 and 8 mm masonry bit	Can give very high vibrations if operators push too hard. Maintaining sharp drill bits is important	7	13	11
General	Grinders – Angle	100–180 mm	Vibration values will depend on force being applied and different materials being worked. Selecting the right grade of abrasive and applying the right forces can help to minimise exposures	3	10	7
General	Grinders – Angle	125 and 100 mm Flapper discs		2	5	4

Industry	Tool type	Tool characteristic, inserted tool, size, process	Notes	Range-lower (10th percentile) (m/s^2)	Range-upper (90th percentile) (m/s^2)	Recommended initial value (75th percentile) (m/s^2)
General	Grinders – Angle	220–300 mm	Vibration values can vary across the many sub-categories and different materials being worked. Applying too much force can produce lobing of the discs and significantly increase vibration levels	4	11	9
General	Grinders – Die			5	10	8
General	Grinders – Straight		Correct selection of the abrasive will ensure that workers do not apply excessive force and keep vibration magnitudes to a minimum	4	9	8
General	Nail guns		Measured vibration levels are dependent upon rates of use. It can be difficult to assess exposure times correctly	3	13	9
General	Needle scalers	Non-vibration reduced		12	26	19
General	Needle scalers	Vibration reduced		3	8	7
General	Nibblers			7	12	12
General	Reciprocating saws		Operator training and work organisation is important. Lower vibrations can be achieved by keeping the tool's nose against the workpiece	7	27	18
General	Sanders – Random-orbital		Vibration magnitudes are very dependent upon applied force. Lower vibration magnitudes can be achieved by applying the correct forces and using the appropriate abrasives	6	14	12

Industry	Tool type	Tool characteristic, inserted tool, size, process	Notes	Range-lower (10th percentile) (m/s^2)	Range-upper (90th percentile) (m/s^2)	Recommended initial value (75th percentile) (m/s^2)
General	Sanders – Orbital		Vibration magnitudes are very dependent upon applied force. Lower vibration magnitudes can be achieved by applying the correct forces and using the appropriate abrasives	4	12	9
Construction	Breakers	Vibration-reduced models with suspended handles or suspended bodies	Lower values can often be achieved by improved operator training	7	18	14
Construction	Demolition or rotary hammers		Can give very high vibrations if operators push too hard. Maintaining sharp drill bits is important	10	21	18
Construction	Plate compactors	Non-vibration reduced		9	22	18
Construction	Plate compactors	Vibration reduced		2	7	4
Construction	Pneumatic hammers		Can give very high vibrations if operators push too hard. Maintaining sharp drill bits is important	10	29	25
Construction	Saws – Cut-off	Masonry cutting		5	14	13
Construction	Scabblers		Well-designed vibration-reduced machines can give vibration values less than 5 m/s^2	4	14	12
Construction	Trench rammers			13	13	13
Construction	Water-jetting guns			1	5	4
Forestry/ horticulture	Brushcutters – Saw blade			3	5	5
Forestry/ horticulture	Chainsaws		Good maintenance is important, eg regular replacement of engine mounts and sharpening saw points	5	7	7

Industry	Tool type	Tool characteristic, inserted tool, size, process	Notes	Range-lower (10th percentile) (m/s^2)	Range-upper (90th percentile) (m/s^2)	Recommended initial value (75th percentile) (m/s^2)
Forestry/ horticulture	Hedge trimmers		Higher vibration values are possible; the data here represents operations on hedges with hedge branches well within the capability of the machines. Vibration values may be higher if the hedge trimmer often has to work hard to cut thicker branches	3	7	6
Forestry/ horticulture	Mowers – Hand-guided			4	8	7
Forestry/ horticulture	Mowers – Ride-on			3	7	6
Forestry/ horticulture	Strimmers	Brushcutter – Strimmer		2	7	7
Engineering	Chipping hammers	Chipping weld		20	32	31
Engineering	Impact wrenches	Drive size: 3/8", 1/2" & 3/4"	Measured vibration levels are dependent upon rates of use. It can be difficult to assess exposure times correctly	3	6	5
Engineering	Impact wrenches	Drive size: 1"	Measured vibration levels are dependent upon rates of use. It can be difficult to assess exposure times correctly	7	11	10
Engineering	Pedestal grinders		Correct selection of the abrasive will reduce the likelihood of workers applying excessive force and will keep vibration magnitudes to a minimum	2	11	8
Engineering	Polishers – Angle (hand-held)	Mop head or soft-backed pad	Vibration magnitudes are very dependent upon applied force. Low-vibration magnitudes are achieved by applying the correct forces	1	3	3

Industry	Tool type	Tool characteristic, inserted tool, size, process	Notes	Range-lower (10th percentile) (m/s^2)	Range-upper (90th percentile) (m/s^2)	Recommended initial value (75th percentile) (m/s^2)
Stone working/ mining/quarrying	Chipping hammers	Chipping stone, concrete, rust	Very high vibration values if the operator holds the chisel (more than 30–40 m/s^2). Low-vibration machines are available that give magnitudes less than 10 m/s^2	11	22	20
Stone working/ mining/quarrying	Rock drills		Vibration values can vary across the sub-categories (eg small and large drill bits and core drills and different materials being worked, such as concrete or stone). Maintaining sharp drill bits and not pushing too hard will achieve lower vibration values	10	28	26
Stone working/ mining/quarrying	Stone hammers		If you are not using a vibration-reducing sleeved chisel then vibration values are likely to be much higher on the chisel hand	7	22	18
Woodworking	Jigsaws			9	17	11
Woodworking	Routers			2	3	3
Woodworking	Staplers			2	6	4

Note: Table 6 is based on common models of tool in use prior to 2015 and will remain useful unless higher vibration models of tool become popular. Where lower vibration tools become available the table will inform an increasingly cautious initial estimate of exposure. Updated and extended information may be posted on HSE's vibration webpages (www.hse.gov.uk/vibration).

Appendix 4 Anti-vibration gloves

1 Several different types of anti-vibration gloves are available but all are generally ineffective at reducing the lower frequencies of vibration that have the greatest effect on vibration exposure. Gloves will generally provide their best vibration reduction at higher frequencies.[22] This reduction will generally be at frequencies above the main vibration frequency of most power tools and at frequencies whose contribution to the frequency-weighted vibration magnitude is likely to be minimal.

2 The amount of vibration reduction provided by gloves depends on the thickness and softness of the lining, which is usually a resilient gel, foam or rubber-like material or an array of air bladders. To protect against lower vibration frequencies the contact areas of the glove need to contain thicker resilient material. Thick gloves can seriously limit dexterity, making them unsafe to use. Comfort may also be affected, making them unacceptable to employees. Gloves may also result in operators having to tighten their grip on the tool and, as a result, actually increase the risk of vibration injury.

3 Gloves marketed in Europe as anti-vibration must carry the CE mark and have been tested and found to meet the requirements of BS EN ISO 10819.[23]

4 BS EN ISO 10819 requires that anti-vibration gloves **on average**:

(a) provide some protection against relatively high vibration frequencies (200 Hz and above);
(b) do not increase the overall vibration magnitude below 200 Hz.

This means gloves can pass the standard test and still provide only negligible or moderate reductions in the frequency-weighted vibration magnitude at the hand.

5 Anti-vibration gloves may increase, rather than reduce, vibration at particular resonant frequencies and still meet the requirements of the standard. This can result in an **increase** in the overall vibration magnitude if the machine or process operates at a rotational speed or impact rate close to a resonant frequency of the glove.

6 The standard test considers only the vibration in one direction and does not consider all directions used in evaluation of vibration exposure. The vibration transmission through the glove is complex, involving both amplification and attenuation, and includes motion of the glove material in combinations of compression and shear. In practice this means that it is not usually possible to predict a protected level of vibration exposure inside the glove.

7 Employers should not issue anti-vibration gloves to reduce vibration exposures unless test data shows that reduction is achieved for the particular combination of glove and machine used, as required by the Personal Protective Equipment at Work Regulations 1992.[24]

8 However, it is acceptable to provide anti-vibration gloves to operators who find that they improve their comfort in their job; for example, holding of components being worked by hammers, or providing warmth, protection against abrasions etc.

9 In summary, before providing anti-vibration gloves check:

(a) whether the gloves are acceptable to employees;
(b) that employees can maintain the necessary levels of dexterity when wearing the gloves;
(c) that the gloves adequately protect employees from risks such as cuts and abrasions or exposure to chemicals;
(d) how long the gloves are expected to last in normal use and the cost of regular replacement.

Appendix 5 Information from manufacturers and suppliers of machinery

1 This appendix tells you what vibration information and advice you should expect from manufacturers, importers and suppliers (including hire companies) of hand-held and hand-guided equipment (power tools, pedestrian-controlled and other machinery). It also points out precautions that may be required when interpreting this information.

The Supply of Machinery (Safety) Regulations (SMR)

2 SMR implements the Machinery Directive (2006/42/EC) which exists to support the free movement of goods within the European Economic Area (EEA). Before machinery is first placed on the market (or first put into service) the 'responsible person', normally the manufacturer or the authorised representative (but may be another such as importer marketing the product under their own name), must design and construct it to meet all relevant essential health and safety requirements; compile and keep a technical file showing how that has been done; provide a Declaration of Conformity and comprehensive instructions in the language of the end user; and affix the CE mark.

3 SMR sets general and specific health and safety requirements regarding vibration. These requirements apply to portable hand-held, hand-guided and mobile machinery. They include:

(a) designing and constructing such machinery so that risks from vibration are reduced to the lowest level, taking account of technical progress and the availability of means of reducing vibration, in particular at source;
(b) providing in the instructions accompanying hand-held or hand-guided machines, and in sales literature describing the performance characteristics of machinery, information on vibration emissions which exceed 2.5 m/s^2; where the vibration does not exceed 2.5 m/s^2 this must be mentioned.

4 It is important to note that, while the threshold in SMR for declaring vibration emission (2.5 m/s^2) has the same numerical value as the EAV in the Control of Vibration at Work Regulations (2.5 m/s^2 *A*(8)), they are measures of different quantities.

5 The vibration emission value(s) supplied with the equipment should be useful to estimate the contribution to daily vibration exposure from this equipment when combining with the estimated duration of daily use.

Reduction of vibration risk

6 Manufacturers are required by SMR to design and construct their products so that risk is eliminated or reduced as far as possible for all foreseeable use (and misuse). They are also required to apply necessary protective measures for risks that cannot be eliminated and inform users of any remaining risks (eg vibration).

7 However, manufacturers' duties to reduce vibration may need to be balanced against important ergonomic factors affecting health and safety, such as weight and dimensions. In some cases, this means producing smaller, lighter machines but with slightly higher vibration.

8 When you are choosing a tool, you should consider risks from vibration in context with other risks. It may not be essential or desirable to choose the machine with the lowest declared vibration emission. For example, a higher-vibration machine with other safety benefits could be more suitable for the particular task as long as you can control the vibration risk.

Provision of information

9 SMR requires that information on vibration emissions must be provided in the instructions accompanying hand-held and hand-guided machinery. Suppliers must pass on this information. Sales literature describing the machinery must not contradict the instructions as regards health and safety aspects and, where describing the performance characteristics of machinery, must contain the same information on emissions as is contained in the instructions. This will:

(a) alert the employer to the vibration emission of machines, and help them select suitable products and design the work processes for which they will be used;
(b) help the employer plan their arrangements to protect their employees.

10 The information provided in instructions should include:

(a) the vibration emission to which the hands and arms are subjected if it exceeds 2.5 m/s^2 – or the fact that it does not exceed 2.5 m/s^2 where this is the case;
(b) the uncertainty of measurement;
(c) warnings to make clear any residual vibration risks that have not been eliminated by design or protective measures, for example:
    (i) where the declared vibration does not adequately represent the vibration risk, perhaps because the standard for vibration testing is known to produce emission values that under-represent risk, or if a tool has more than one mode of use and the vibration declaration is not representative of the risk in all modes of use;
    (ii) any measures needed to keep residual risks from vibration under control when the machine is used, such as the type or condition of inserted tools or consumables (eg grinding disc, blade chisel, drill bit etc) which may affect the vibration emission;
    (iii) any particular training to ensure that low-vibration exposures are achieved and sustained, such as workers applying the correct force when using breakers with vibration-isolating handles;
    (iv) any particular maintenance of the equipment required to ensure continued use without risk from vibration, such as periodic inspection and replacement of the anti-vibration handle mounts on a chainsaw.

Manufacturers' declared vibration emission values

11 The responsible person (the manufacturer or another taking on the manufacturer's role) has a duty to declare vibration emission data and usually does so according to harmonised European vibration test codes. Vibration test codes for different types of machines are listed on the European harmonised standards webpage supporting the Machinery Directive (see Further information). In Britain, these test codes are published as British Standards.

12 SMR requires that two values describing the vibration emission should be reported by tool manufacturers:

(a) *a* (the measured vibration emission);
(b) *K* (the uncertainty of *a*).

13 Standard test codes for vibration emission can usually be used reliably to identify the higher and lower vibration equipment when the declared emissions are significantly different, say, 7 and 17 m/s^2, but may not be reliable to identify the higher and lower vibration equipment if the declared emissions are, say, 7 and 8 m/s^2.

14 The difference between the *a* values for two tools should not be considered significant if it is smaller than one of the quoted *K* (uncertainty) values. For example, tools A and B in the following example should be considered to have the same vibration emission (in the absence of additional information showing one tool to have lower vibration than the other):

Tool A $a = 7$ m/s^2 $K = 2.7$ m/s^2

Tool B $a = 5$ m/s^2 $K = 2.1$ m/s^2

The difference in reported vibration emission is $7 - 5 = 2$ m/s^2. The difference in this case is smaller than either of the reported uncertainty values, *K*. Therefore, it is not clear (without further tests) that Tool B with the lower reported vibration will, in fact, have a lower vibration than Tool A during normal use.

15 Vibration test codes should conform to the general principles given in BS EN ISO 20643.[25] Where no test code exists for a specific type of tool, BS EN ISO 20643 can be used to determine vibration emission. In this case, the test house should select operating conditions for vibration tests with care and should report the test procedures they have adopted in the instructions, including:

(a) machine configuration, operating and loading conditions during the test;
(b) the positions and directions in which the vibration was measured.

16 Good-quality vibration emission data will help you to:

(a) compare the vibration of different brands and models of the same type of machine;
(b) identify (and avoid) machines that have particularly high vibration emissions;
(c) consider any significant differences in the vibration of a range of machines which are, in other respects, suitable for the particular task;
(d) make an estimate of daily exposure;
(e) compare the estimated daily exposure with the EAV and ELV and decide what actions you need to take (for example, limiting the time employees spend on some tasks in any one day).

Limitations of manufacturers' declared emission values

17 In real workplace use, the magnitude of vibration that the user of a machine is exposed to varies with task, operator technique, choice of consumables (eg drills, abrasives), tool and consumable wear and damage etc. The tool manufacturer's declared vibration emission value should have been measured in accordance with an appropriate harmonised standard. The standardised tests are carried out under controlled conditions designed to eliminate much of the variability that occurs during real use. However, the vibration magnitudes determined from standardised tests may not represent the vibration experienced by tool operators in real world

conditions. Manufacturers' vibration emission data may under- or over-estimate actual vibration magnitudes depending on the type of tool and the standardised test method.

18 Before using manufacturers' vibration information to assess the risk of using a machine in your workplace, you should check (for example, with the manufacturer and/or supplier) that the declared vibration emission level is representative of your intended use. Manufacturers are obliged to provide vibration emission values representative of normal intended use of the machine. However, if you fit an accessory that is not supplied by the manufacturer or not covered by the vibration test code, for example fitting a cup brush to an angle grinder, the manufacturer may not provide information relevant to your application. See Appendix 3 for examples of vibration magnitudes measured during normal uses of some common machines.

19 When estimating vibration exposure values, add the uncertainty value, *K*, to the declared emission value, *a*. If the emission values are a reasonable guide, then the *a*+*K* value gives a vibration value that errs on the safe side and can be sufficient to indicate likely vibration magnitudes for a wide range of tasks.

20 You should be cautious when comparing vibration emission values. You should establish that all the machines you are considering have vibration declared according to the same standard. The vibration emissions of machines with different power sources (electric, pneumatic, internal combustion-powered) may be obtained using different test codes and may not be comparable. If you cannot establish the standard used from the manufacturer's literature, you may need to ask your supplier(s) to confirm that the standard test codes used have the same number, same part (if in parts) and the same date.

21 Comparable types of modern equipment often have similar vibration emissions. It has become more difficult to reduce vibration exposures by selecting between equipment than it once was but large differences in the vibration emissions of some competing tools do still exist, particularly for percussive tools. You should aim to avoid tools with vibration emission significantly above the average for the tool type. See Appendix 3 for examples of vibration magnitudes measured during normal uses of some common machines.

22 In cases where vibration test codes fail to report a vibration emission that is representative of workplace vibration and there is still a risk from vibration, manufacturers should warn you of any residual risk so that you can plan your use of the equipment without risk from vibration. This may be the case for some or all machines in a class. For example, the vibration test code BS EN 60745-2-6:2003+A2:2009[26] for electric hammers provides values that are representative of the vibration of hammers in the middle of the mass range. However, this same standard test under-predicts the workplace vibration of small hammers and can over-predict the workplace vibration of large hammers.

23 There is no prescribed way of reporting supplementary information on vibration risk. BS EN 12786[27] provides guidance to those writing vibration test codes on the information for use that will help users manage risk from vibration. The standard requires:

(a) the reporting ranges of vibration magnitudes for foreseeable uses of the machine;
(b) if applicable, providing recommended maximum times for which an individual should use the machine within a day.

Training requirements

24 Some operators of powered equipment may require training to ensure that minimal vibration exposures are achieved and sustained. It may also be necessary to train others such as those who will undertake maintenance of machines. Equipment must be supplied with information that alerts users to the particular training required. This might include:

(a) the need to train operators in the correct use of vibration-reduction features (eg correct grip and push forces for powered hand tools with suspended handles);
(b) highlighting any applications of the machine that produce unusually high vibration emissions;
(c) information about particular methods of using the machine that greatly affect the emitted vibration;
(d) information on any specific training required by maintenance staff to ensure continued low-vibration operation of the machinery.

Presentation of information, labelling and marking

25 The information on residual risks from vibration (or any other hazards) should be provided in a way that will be understood easily by the user, for example using labels with readily understandable pictograms or written information in an appropriate language. Warning information should be included in the instructions accompanying the machine and may also appear in catalogues or in separate data sheets. A suggested format for this information is given in Appendix 6.

26 The CE mark indicates that the machinery has been designed and manufactured to meet all the relevant requirements of any relevant EU supply Directives for the product, including those for vibration required by the Machinery Directive/SMR (see Appendix 5 paragraphs 2–3). The Declaration of Conformity accompanying the machine should tell you which Directives apply and which Standards were followed in its design and manufacture.

Second-hand equipment

27 SMR does not apply to machinery first supplied or put into service in the EEA before 1993. However, section 6 of the HSW Act requires designers, manufacturers, importers and suppliers of equipment for use at work (including machinery) to ensure, so far as is reasonably practicable, that it is designed and constructed to be safe and without risks to health at all times when it is being set, used, cleaned or maintained by a person at work. They must also provide adequate information on the use for which the equipment is designed so that it can be used safely and without risk to health.

28 Suppliers of second-hand machinery may be able to rely on information originally supplied with the machine if this is available and sufficient. However, they may need to provide new information if, for example, the original information is no longer available; if the machine has been significantly modified, so that the existing information is no longer valid; or if the original information did not meet the standard required.

29 Second-hand machinery which is ‘new’ to Europe is subject to SMR and its detailed provisions, including those for vibration.

Appendix 6 Guidance for machinery manufacturers: A suggested approach to warning of residual risk from vibration

1 Machinery manufacturers and suppliers have duties, under SMR, to minimise risk from vibration during design and construction of equipment. Information provided with equipment should describe any remaining vibration risk and how to control it so that the equipment can be used without risks from vibration.

2 Supplying vibration information in accordance with harmonised European standards can provide manufacturers with a presumption of conformity with the essential health and safety requirements addressed in those standards. Harmonised standards for vibration test codes for different types of machines can be found in the harmonised standards webpage supporting the Machinery Directive (see Further information). In Britain, these test codes are published as British Standards. Harmonised standards for vibration test codes do not always produce emission values that adequately represent vibration risk. Methods of providing adequate supplementary information on vibration risk are set out in BS EN 12786. Harmonised safety standards should follow BS EN 12786 to guide provision of sufficient supplementary information about vibration risk.

3 The following fictitious example for a chipping hammer shows how, in the instruction manual supplied with the equipment, a manufacturer might present information on: vibration risks (Example 1a) and reduction of vibration risks (Example 1b).

Example 1a

Risk of hand-arm vibration injury

Vibration emission
Chipping hammer, make ABC, type 123, model 45, when operated in accordance with these instructions and tested in accordance with BS EN ISO 11148-4:2010[28] and BS EN ISO 28927-10:2011[29] results in the following vibration emission declared in accordance with BS EN 12096:1997.

Measured vibration emission value	*a*	8.0 m/s^2

Uncertainty	*K*	2.3 m/s^2

These values are suitable for comparison with the vibration emission levels of other machines that have been obtained using the same test method.

This tool may cause hand-arm vibration syndrome if its use is not adequately managed.

The vibration emission from chipping hammers varies greatly with the task and with the operator's grip and the feed force. We believe that in the normal intended use of the machine the vibration magnitudes at the hand position on the body of the tool will usually vary between 15 and 20 m/s^2 (vibration total value), depending on the details of the task. However, magnitudes outside this range may occur for some applications. A figure of 18 m/s^2 is probably a useful in-use vibration magnitude, say, for estimating the likely average exposures (and hence risk) of tool users performing a wide range of tasks within the intended use of the tool (in accordance with BS EN 5349-1:2001 for the exposures).

We point out that application of the machine to a sole specialist task may produce a different average emission and, in such cases, we recommend a specific evaluation of the vibration emission, but we would expect the average to fall between 15 and 20 m/s^2.

Example 1b

Recommended measures to reduce the risk of hand-arm vibration syndrome

Restricting exposure time
Use of the machine for more than 10 minutes (hands-on, power-on) in any one day is likely to exceed the Control of Vibration at Work Regulations' exposure action value for hand-arm vibration. The machine should never be used for more than 40 minutes in any one day as this is likely to exceed the exposure limit value. If there is exposure to hand-arm vibration from other sources then the use of this machine must be reduced accordingly.

Correct use and maintenance
The vibration emission is closely linked to the operating pressure in the air supply. You should ensure that the pressure is set in accordance with our recommendations to assure optimum efficiency with minimised vibration exposure.

The transmission of vibration to the user is reduced by the inclusion of components *A* and *B*. The condition of these components should be checked and they should be replaced every *n* months during routine maintenance and earlier if they show signs of wear.

Health surveillance
If this tool is to be used regularly by one operator for more than around 10 minutes per day, or alongside other vibration tools, we recommend an appropriate programme of health surveillance to detect early symptoms so that management procedures can be modified to prevent disability.

Personal protective equipment
We are not aware of any personal protective equipment (PPE) that provides protection against vibration injury by attenuating the vibration emissions of this machine. We recommend a sufficient supply of clothing (including gloves) is available to operators to enable them to remain warm and dry and maintain good blood circulation in fingers, hands and arms.

4 Where a machine is designed for a well-defined use it is sometimes helpful to describe the recommended maximum daily use in terms of work done, rather than simply the exposure duration. For example, the manufacturer could advise that a drilling machine can be used to drill a certain number of holes (of known size in a known material) before the EAV or ELV is likely to be reached. Using a highly efficient tool with relatively high vibration may be more productive and result in a lower vibration exposure than using a lower-vibration, less efficient tool for the time required to complete the job. The following example shows how the manufacturer of a hammer drill might present this information.

Example 2

Recommended measures to reduce the risk of hand-arm vibration syndrome

Limiting exposure time
The machine should not be used by any individual regularly for more than about 20 minutes (hands-on, power-on) in any one day; a longer exposure time is likely to exceed the exposure action value for hand-arm vibration. The machine should never be operated by any individual for more than about 1 hour 20 minutes in any one day as this is likely to exceed the legal exposure limit value. The duration of use should be further reduced if the individual is also exposed to hard-arm vibration from other sources on the same day.

Tests have shown that this machine is capable of drilling the following number of holes in concrete (40 N/m^2 compressive strength) before the operator reaches the exposure action and limit values:

To exposure action value:	50–60 holes 100 mm deep or equivalent
To exposure limit value:	200–240 holes 100 mm deep or equivalent

These figures apply to a machine in good condition, with a sharp insert (type XYZ, diameter 5–14 mm), operated in accordance with these instructions.

Appendix 7 Training and competence for those advising employers

1 The Vibration Regulations require employers to manage risk from vibration based on a suitable and sufficient assessment of those risks. For many employers this will be a straightforward process and they will be able to follow the guidance in Part 2, supplemented by HSE's HAV webpages at www.hse.gov.uk/vibration, without professional help. Some employers may need to appoint one or more of their employees to undertake these tasks, while others will wish to employ external assistance to help them with some or all of these functions.

2 This appendix gives advice on appropriate levels of expertise, and on what training may be required, for those advising employers on HAV risks and helping them comply with the Vibration Regulations.

3 Advice on suitable expertise and training courses for occupational health professionals providing a health surveillance service for HAVS is given in Part 3, paragraphs 185–187.

Risk assessment and planning control actions

4 People who help employers achieve control of vibration risks must be able to follow the guidance for employers in Part 2. In general, they should have:

(a) knowledge of the work processes in the industry concerned and familiarity with compliance in respect of control of vibration risks;
(b) an understanding of the purpose of risk assessment and how to identify potential risk control measures, determine how the Vibration Regulations apply based on exposure, and form a view on the reasonable practicability of the actions that could be taken;
(c) an understanding of how to obtain and interpret information on vibration risks, including the limitations of manufacturers' declared emission values and the sources of alternative information about the likely vibration emitted by the equipment in use;
(d) the ability to assess daily exposures from information on vibration magnitudes and exposure durations;
(e) where measurements of HAV are made, competence in measurement and interpretation of those measurements;
(f) the ability to record their findings and decisions, and explain them to others;
(g) an understanding of their own limitations, whether of knowledge, experience or resources.

Training

5 Formal training is not a legal requirement. However, those offering a commercial service to dutyholders, and employers using their own personnel for this purpose, may wish to assure themselves that their staff have a suitable level of

knowledge and expertise. Successful measurements of vibration in the workplace (if required) are particularly dependent upon adequate expertise and experience.

6 A course covering the topics in Table 7 should provide a basis for dealing with most industrial vibration exposures, and recognising where more specialised expertise (for example, in-depth knowledge of an industrial process or the engineering application of vibration control) may be needed. Courses should ideally include a substantial practical element and conclude with an assessment of the student's theoretical and practical competence.

7 Short training courses are available to suit a range of delegate requirements from machine users to those advising employers. Providers include universities, colleges, consultancies and other institutions. Some courses, organised through local training providers, are accredited by professional organisations, including the following:

The Institute of Acoustics
Silbury Court
406 Silbury Boulevard
Milton Keynes
MK9 2AF

Tel: 0300 999 9675
www.ioa.org.uk

British Occupational Hygiene Society
5/6 Melbourne Business Court
Millennium Way
Pride Park, Derby
DE24 8LZ

Tel: 01332 298101
www.bohs.org

Table 7 Typical topics for training courses on HAV risk management

Topic	Important content	Useful additional content
Legal requirements	Duties of employers to assess and manage risks from HAV: ■ The Control of Vibration at Work Regulations 2005 ■ The Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 2013 Duties of manufacturers and suppliers of machinery: ■ Supply of Machinery (Safety) Regulations 2008	■ The Health and Safety at Work etc Act 1974 ■ The Management of Health and Safety at Work Regulations 1999 ■ The Provision and Use of Work Equipment Regulations 1998 ■ The Personal Protective Equipment at Work Regulations 1992 ■ The Workplace (Health, Safety and Welfare) Regulations 1992 ■ The Physical Agents (Vibration) Directive 2002/44/EC ■ Harmonised European machinery safety standards
Theory of vibration	Basic concepts: ■ displacement, velocity and acceleration ■ root-mean-square time averaging ■ vibration frequency	Typical characteristics of sources of HAV, eg rotary, reciprocating and percussive tools
Effects on health	HAVS: ■ neurological effects ■ vascular effects ■ musculoskeletal effects Carpal tunnel syndrome	Development of symptoms, dose-effect relationships Clinical and laboratory techniques used in diagnosis of HAVS

Topic	Important content	Useful additional content
Determining vibration magnitudes	Interpretation of manufacturers' declared emission values: ■ measurement conditions and standard methods ■ appreciation of uncertainty Principles of vibration measurement according to BS EN ISO 5349 Parts 1 and 2: ■ identifying the need for measurement in the workplace ■ frequency weighting ■ 3-axis vibration measurement techniques ■ sampling strategies and appreciation of uncertainty ■ recording and presenting vibration data	■ Harmonised European vibration test codes Required if measurement is to be undertaken: ■ instrumentation and calibration ■ accelerometers and mounting methods ■ sources of measurement error ■ practical experience
Determining vibration exposures (calculation of *A*(8))	■ Understanding of daily vibration exposure *A*(8) according to BS EN ISO 5349-1 ■ Calculation of (partial) exposure from one tool or process ■ Calculation of overall daily exposure from multiple vibration magnitudes and exposure times ■ Recording and presenting the exposure results ■ Comparison with the EAV and ELV	Use of exposure assessment tools provided by HSE: ■ exposure points system ■ exposure calculator ■ exposure ready-reckoner
Control of exposure	Elimination or reduction of vibration exposure by, for example: ■ substitution of new work processes ■ modification of process ■ improving quality of manufactured product Reduction of vibration exposure by, for example: ■ selecting lower-vibration machine and equipment ■ maintenance of equipment ■ operator training Reduction of daily exposure time by: ■ exposure points system ■ job rotation ■ permit-to-work systems ■ more efficient tools and machinery	Vibration sources – general principles of vibration generated by hand-held equipment and application of engineering principles to vibration control. For example: ■ auto-balancing for rotary machines ■ vibration isolation handles ■ energy absorption
Health surveillance	■ Setting up a health surveillance scheme ■ Selecting an occupational health provider ■ Using health surveillance data to monitor control measures ■ Management of affected workers	Strategies and techniques for health surveillance

Topic	Important content	Useful additional content
Personal protective equipment	Use of clothing and gloves to keep warm to prevent blanching attacks etc Anti-vibration gloves, their role, likely performance limitations and challenges in assessing their performance	The standard for anti-vibration gloves, BS EN ISO 10819
Guidance and literature	Introduction to sources of information, eg: ■ HSE publications ■ trade associations ■ trade unions ■ British, European and International standards	■ EU Non-binding guide to good practice for the implementation of Directive EC 2002/44/EC

Note: This topic list is suggested as the basis for general courses. It may need to be amended to suit courses intended to train people for a particular range of tasks, eg those concerned with the management of HAV within a particular industry or company.

Appendix 8 Guidance on health surveillance for occupational health professionals

A detailed account of clinical assessment and diagnosis for hand-arm vibration syndrome

Other information on health surveillance is found in Part 3.

Why is health surveillance required?

1 Regulation 7 of the Vibration Regulations requires employers to provide suitable health surveillance where the risk assessment indicates a risk to employees' health.

2 Health surveillance should be instituted for:

(a) employees who are likely to be regularly exposed at or above the EAV;
(b) employees likely to be occasionally exposed at or above the EAV where the risk assessment identifies that the frequency and severity of exposure may pose a risk to health;
(c) employees who have a diagnosis of HAVS (even when exposed below the EAV).

Competency and training

3 It is essential that health professionals involved in health surveillance for HAVS can demonstrate that they have the necessary expertise. Specialist training is required to carry out adequate clinical assessments and reduce the likelihood of misdiagnosing symptoms of HAVS. The diagnosis may be difficult and require special tests. Appropriate qualifications for health surveillance of HAVS are found in paragraphs 185–187 of Part 3.

The health surveillance programme

4 It is important to give adequate information to employees on what the health surveillance programme aims to achieve and why their full co-operation is important. Occupational health professionals who are providing clinical assessment and overseeing the health surveillance programme can help employers explain the serious nature of the disease and the aims of health surveillance. There is a need to ensure that employees are aware that the results of their health surveillance, with respect to fitness for work, will be disclosed to their employer, and that no clinical information can be given to anyone else without their consent.

5 The aims of the health surveillance programme are primarily to safeguard the health of employees (including identifying and protecting individuals at increased risk), but also to check the long-term effectiveness of control measures. One of the specific aims is to prevent employees developing a degree of HAVS that is associated with disabling loss of hand function. Health surveillance for HAVS is appropriate where a risk assessment has shown the need and it should operate alongside a programme of vibration risk control measures (see Part 2).

6 Cases of the occupational diseases HAVS and vibration-induced carpal tunnel syndrome diagnosed by a doctor will be reportable by the employer in accordance with RIDDOR.

7 When health surveillance is required, it should be carried out at least annually. Both initial (or baseline) assessment and periodic health surveillance are needed for HAVS. Early assessment of newly exposed employees is recommended as susceptible individuals can develop symptoms in six months or less. Exposed employees should receive information on why and how to detect and report symptoms of HAVS.

A tiered approach to health surveillance – Tiers 1 and 2

8 To identify employees with symptoms that require further investigation, questionnaires are used in Tiers 1 and 2 of the recommended tiered approach to health surveillance (see Part 3 and Appendix 9). Tier 1 uses a questionnaire to gather information regarding fitness to work with HAV. The Tier 2 questionnaire identifies HAV exposed workers with symptoms requiring further investigation.

Clinical assessment – Tiers 3 and 4

9 The remaining information presented in this appendix helps to explain the procedures for carrying out a clinical assessment for Tiers 3 and 4 and for completing the clinical questionnaire which can be found in Appendix 9.

10 A comfortable or warm room temperature is recommended for the clinical examination. The individual's history of symptoms and any relationship with the person's work needs to be recorded. The questionnaire contains a free text area to record responses at the start of the interview. Open questions such as 'What problems, if any, do you have with your hands?' should be asked.

Medical records

11 Completed medical questionnaires and the details of the medical examination form confidential medical records relating to individuals, which are held by the occupational health professional. Employees should be informed of the results of their assessment and of any implications of the findings, such as the likely effects of their continuing to work with vibration.

Occupational history

12 The leading hand is the hand nearest to the source of vibration, if this can be identified. It should not be assumed that this hand will be more badly affected as cases will vary and depend on the variety of jobs, hand positions and tools used. All activities involving exposure to vibration are relevant. The 'trigger' or contact time is the estimated time for which the hands are actually exposed to vibration. This will often be considerably shorter than the period during which the tool is said to be used, especially where tools are used repeatedly for short duration tasks, eg drilling or using an impact wrench.

13 Some chemical agents are neurotoxic and may cause neurological symptoms similar to those of HAVS. These include exposure to lead or certain solvents.

Social history/leisure pursuits

14 Sources of vibration exposure and approximate 'trigger' times need to be recorded. Use of motorcycles should be included in leisure activities.

Medical history

15 Any injuries or surgery to the hand, arm or neck will need to be considered as part of the clinical assessment.

16 Raynaud's disease (primary Raynaud's) affects about 3% of men and about 10% of women. As part of a differential diagnosis of HAVS, it is appropriate to address whether there is reasonable certainty that the person does not have Raynaud's disease. Factors in favour of Raynaud's disease include early age of onset (teens or twenties), usually a description of other cold extremities (ears, feet, nose), a symmetrical pattern of blanching and family history.

17 A number of medical conditions can lead to a tendency to report similar vascular symptoms to those of HAVS, ie secondary Raynaud's phenomenon. In fact, many of these conditions are associated with a complaint of cold extremities and do not cause arterial vasospasm.

18 The symptoms attributed to the neurological component of HAVS may arise from some medical conditions and drug treatments. These include diabetic peripheral neuropathy or treatment with streptomycin or cyclosporine. Drugs such as beta-blockers are also implicated in the causation of Raynaud's phenomenon, and therefore can mimic (or worsen) the vascular component of HAVS.

19 In addition, a number of chemicals in the workplace can cause peripheral neuropathy.

Clinical assessment of HAVS

Hand symptoms

20 Symptoms of HAVS are described in Part 3 but some additional information is given here.

21 Tingling and numbness may occur as part of a normal physiological response to the use of vibrating tools. If this response lasts more than 20 minutes it is more likely to be part of a pathological process. Numbness is also associated with vasospasm. Numbness occurring separately from blanching is of prime interest as this may indicate the neurological component of HAVS. Tingling in HAVS is usually worsened by cold exposure. Symptoms of tingling or numbness in the fingers at night or on arm elevation may indicate carpal tunnel syndrome. The latter can be caused by exposure to vibration. It is characterised by:

(a) median nerve distribution of tingling and pain;
(b) being woken at night by hand symptoms such as pain or numbness;
(c) pains in the wrist radiating into the forearm;
(d) median nerve distribution of blunting of sensation;
(e) positive Tinel and Phalen's tests (see paragraph 34 of this appendix);
(f) wasting of the thenar eminence (occurs in more severe cases).

22 Employees may volunteer that certain actions such as flicking or shaking the hands relieves symptoms of carpal tunnel syndrome.

23 There should be sufficient detailed description of the attacks of blanching to differentiate between abnormal arterial vasospasm (Raynaud's phenomenon) and a normal physiological response to cold. Vasospasm that reflects the vascular component of HAVS causes whiteness initially affecting the tips of the digits and then extending proximally to the palm. The whiteness is usually circumferential and there will be a sharp line of demarcation between normal and abnormal skin colour. Blotchiness or diffuse paleness of the skin is not what is meant by blanching in this context. Whiteness may be followed by blueness and redness due to the hyperaemic phase.

24 Blanching attacks are more likely to occur in the winter months because cold is the main trigger. Attacks lasting many hours or days are not related to abnormal vasospasm since the latter are known to last about 20–60 minutes. 'At other times?' on the questionnaire might refer, for example, to emotion acting as a trigger. Whiteness in the toes/feet is more likely to indicate primary Raynaud's (Raynaud's disease) although there is a possibility that exposure to vibration can affect non-exposed extremities in HAVS cases where fingers blanch. The hammer syndromes (hypothenar and thenar) should be considered where the history is suggestive and blanching is not typical of HAVS. Blanching due to HAVS may only rarely be witnessed by the occupational health professional. Therefore, photographic evidence of finger blanching, eg on a smartphone, should be requested from the worker (see Figure 5).

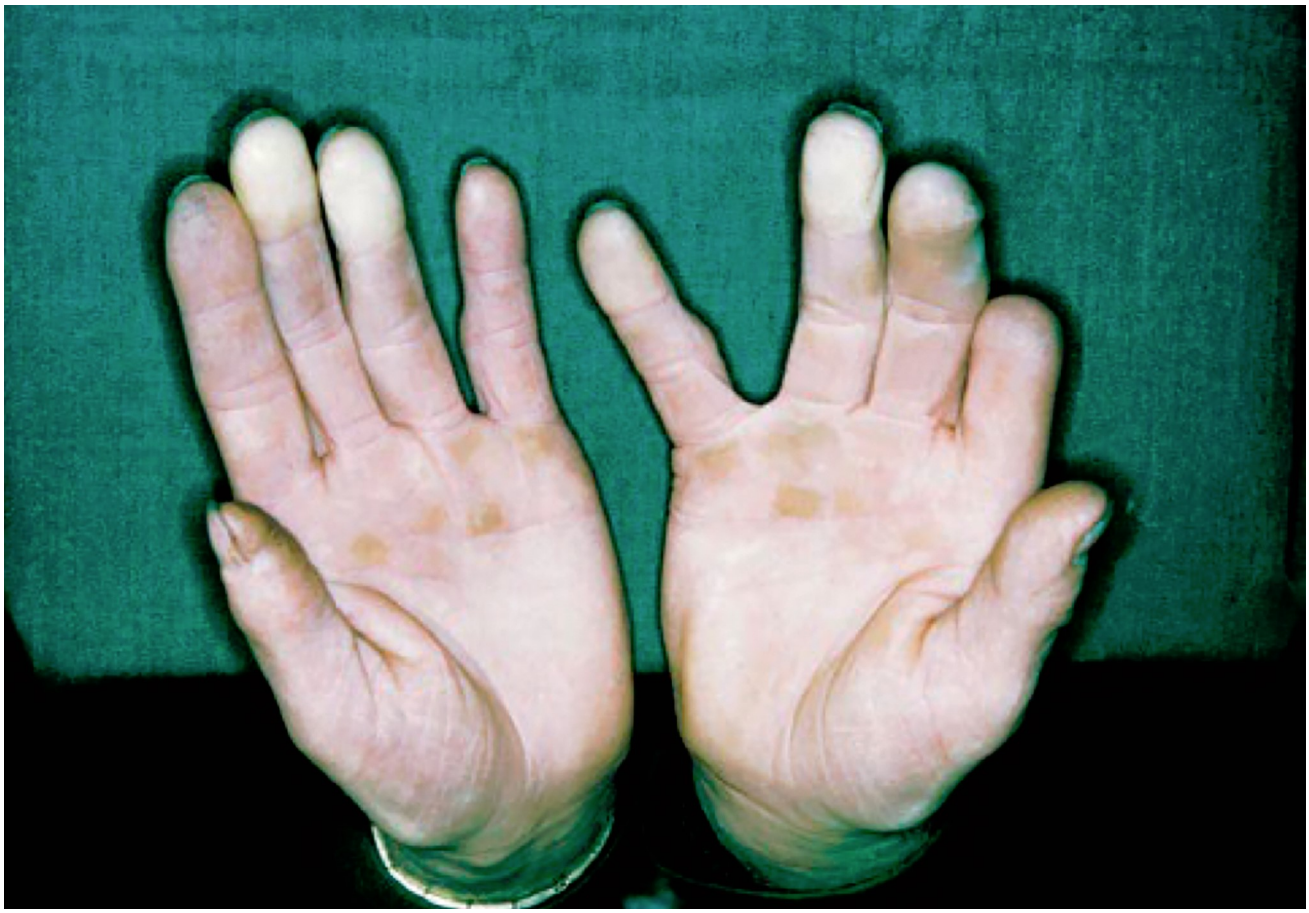


Figure 5 Blanching

25 Difficulties may be experienced, for example, when fastening buttons or manipulating small objects which may result from areas of reduced sensitivity or loss of dexterity in an individual suffering from the neurological component of HAVS. It is important to ascertain if this is during attacks of blanching (in cold weather) or if it occurs when the fingers are warm and the person is in a warm environment.

26 Musculoskeletal symptoms in the upper limb may be caused by risk factors such as working posture and not vibration, or by a combination of vibration exposure and handling heavy tools while applying a large grip force.

Examination

27 A clinical examination is carried out to, where possible, diagnose HAVS or CTS and exclude differential diagnoses (see clinical questionnaire in Appendix 9).

28 If a neuropathy is suspected from an examination of the hands and/or medical history, an examination of the feet is necessary and a check for an autonomic neuropathy should be made. If pulse volume or blood pressure is reduced in either arm, evidence of a subclavian bruit should be sought.

29 The Allen test examines the patency of the palmar arches and digital arteries. Normal anatomical variations may give rise to false positive results in this test. The examiner, standing, uses the fingers of each hand to compress the radial and ulnar arteries at the wrist and then raises the subject's hand while the subject opens and closes the hand to empty the palmar arches and subcutaneous vessels. The hand is then lowered and one of the arteries released. Prompt flushing of the hand indicates a normal contribution from the tested artery. Faint and delayed flushing of the fingers indicates that either the deep palmar or the digital arteries are occluded. A delay of more than five seconds indicates digital artery occlusion.

30 Monofilaments, such as Semmes-Weinstein monofilaments, can be used to test perception of light touch and deep pressure. They should be calibrated according to the manufacturer's recommendations. The testing kit consists of probes of varying thickness of nylon, which are presented to the subject until the probe deforms at a defined force. Recognition is recorded in a standardised way and the test should be performed with the subject having no visual clues to the application of the monofilaments.

31 The Purdue pegboard can be used to help assess manipulative dexterity. The test instructions should be followed and an assessment made separately for each hand. An alternative system, the nine-hole peg test, can also be used but is likely to give less adequate information. Both systems have normative data available. If these tests are not available, qualitative assessment can be made using a selection of small coins, washers or bolts. Deficit in manual dexterity associated with severe cases of the neurological component of HAVS is usually evident during medical interview in the manner in which the subject handles pieces of paper, uses a pen and grasps and turns door handles.

32 Adson's, Tinel's and Phalen's tests should be used, where appropriate.

33 Adson's test is only necessary where the history of positional symptoms points to thoracic outlet syndrome. During deep inspiration, with the neck extended and rotated to the side being tested, the shoulder in abduction and extension, the radial artery at the wrist is palpated. In the presence of subclavian obstruction, the radial pulse is reduced or absent. The false positive rate is about 10%.

34 Tinel's and Phalen's tests are used to elicit symptoms indicative of carpal tunnel syndrome and are therefore appropriate to use when the subject complains of tingling in the fingers in the median nerve distribution. For Tinel's test, the subject's hand and forearm are rested horizontally on a flat, firm surface with the palm uppermost. The examiner then percusses the carpal tunnel. A complaint of tingling in the subject's fingers in the median nerve distribution is indicative of carpal tunnel syndrome. In Phalen's test, the subject raises their arms to chin level and then allows both hands to flex at the wrist by gravity. This posture should be maintained for one minute. Tingling in the fingers in the median nerve distribution is indicative of compression of the median nerve under the carpal ligament.

35 Grip strength should be tested using a dynamometer. A standard handle position is usually used for each test. Standardised protocols have employed:

(a) the subject seated, shoulder adducted, neutral rotation, elbow flexed at 90 degrees and the arm unsupported;
(b) standing while lowering the arm from the outstretched horizontal position, ensuring that the dynamometer does not touch the thigh.

36 The final page in the questionnaire gives space to record the overall results of the assessment. Results from any further investigations can be recorded on the form.

Classification of HAVS symptoms

37 The classification scheme known as the modified Stockholm Workshop scales should be used to classify neurological and vascular symptoms (see Table 8).

38 A system for allocating a weighted numerical value to each phalange affected and calculating an overall score for finger blanching in each hand is used in the Griffin method outlined in HSE Contract Research Report (CRR) 197/98 (Figure 6).[30] This system is a useful method in practice for monitoring progression of symptoms in individual fingers. It does not take account of the frequency of attacks, which may be more relevant in assessing functional disability. Attacks can lead to a variable degree of blanching. In this case, the worst distribution should be recorded.

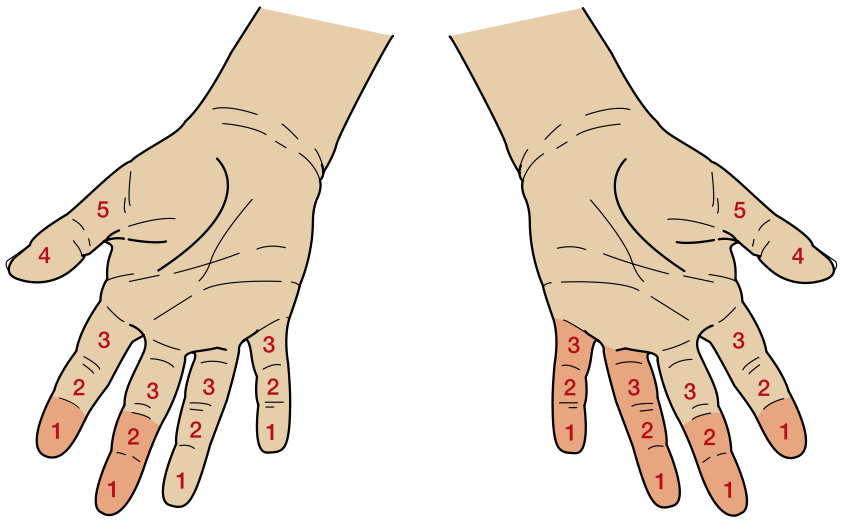


Figure 6 Numerical scoring of vascular symptoms of HAVS

Table 8 Modified Stockholm Workshop scales

Stage	Criteria	Assessment	
		Left hand	Right hand
Sensorineural			
0_{SN}	Vibration exposure but no symptoms		
1_{SN}	Intermittent numbness and/or tingling (with a sensorineural, SN, score of >3 and <6)		
2_{SN} (early)	Intermittent numbness, and/or tingling, reduced sensory perception (usually an SN score of >6, <9)		
2_{SN} (late)	Persistent numbness, and/or tingling, reduced sensory perception (usually an SN score of >9, <16)		
3_{SN}	Constant numbness and/or tingling, reduced sensory perception and manipulative dexterity in warmth (and an SN score of >19)		
Vascular			
0_{V}	No attacks		
1_{V}	Attacks affecting only the tips of the distal phalanges of one or more fingers (usually a blanching score of 1–4)		
2_{V} (early)	Occasional attacks of whiteness affecting the distal and middle (rarely also the proximal) phalanges of one or more fingers (usually a blanching score of 5–9)		
2_{V} (late)	Frequent attacks of whiteness affecting the distal and middle (rarely also proximal) phalanges of one or more fingers (usually a blanching score of 10–16)		
3_{V}	Frequent attacks of whiteness affecting all of the phalanges of most of the fingers all year (usually a blanching score of 18 or more)		
4_{V}	As 3_{V} and trophic changes		

Definitions
Intermittent – not persistent
Persistent – lasting more than 2 hours
Constant – present all of the time
Occasional – 3 or fewer attacks per week
Frequent – more than 3 attacks per week

Note: The staging is made separately for each hand. The grade of disorder is indicated by the stage and number of affected fingers on both hands, eg stage/hand/number of digits.

39 In the numerical scoring system for vascular HAVS, the blanching for each part of each digit is given a score as shaded on the diagram in Figure 6. A total value for each hand can be arrived at by summing the digit scores. In the figure, the score for the left hand is 16 and that for the right hand is 4.

40 Stage 2 sensorineural is broad, ranging from less severe neurological symptoms to those with persistent sensorineural loss. Therefore, stage 2 should be divided into early and late phases to assist with management of stage 2 cases.

41 Lawson and McGeoch have published a method of adapting the modified Stockholm Workshop classification scheme to divide stage 2.[31] They have used the sum of the scores from the two optional standardised sensorineural tests in Tier 5 to divide the sensorineural stage 2 into early and late. These tests are:

(a) vibrotactile perception threshold (VPT);
(b) thermal (temperature) perception threshold (TPT).

42 Details of the test methods can be found in HSE's CRR 197/98. It should be noted that test conditions and methodology need to be carefully controlled.

43 Dividing sensorineural HAVS stage 2 in the absence of the Tier 5 test results relies upon categorising numbness/tingling symptoms as intermittent or persistent. This will be less effective than use of Tier 5 testing.

44 Currently, there is no consensus among UK testing practitioners on a vascular test that is sufficiently robust to be recommended for the diagnosis of HAVS.

45 The scores relating to the vibrotactile perception threshold and thermal perception threshold tests are derived using the scheme given in Table 9. Numbness and tingling are given equal weighting in this adaptation.

Table 9 Scoring system for the standardised sensorineural tests

Vibrotactile threshold test (index and little finger)			
At 31.4 Hz	< 0.3 m/s^2 Score = 0	≥ 0.3 m/s^2, < 0.4 m/s^2 Score = 1	≥ 0.4 m/s^2 Score = 2
At 125 Hz	< 0.7 m/s^2 Score = 0	≥ 0.7 m/s^2, < 1.0 m/s^2 Score = 1	≥ 1.0 m/s^2 Score = 2
Thermal perception threshold test (1 degree/second, index and little finger)			
Temperature neutral zone	< 21ºC Score = 0	≥ 21°C, < 27°C Score = 2	≥ 27°C Score = 4

46 Reduced sensory perception can be assessed by the use of Semmes Weinstein monofilaments and reduced manual dexterity by the Purdue pegboard as described in paragraphs 30–31 (this appendix). If a loss of dexterity in a warm environment is diagnosed, and the total score for the two sensorineural tests is 9 or higher, then a score of 10 is added to this result but only if the Purdue pegboard result is abnormal. Hence the scoring criteria for stage 3 sensorineural is 19 or above in Table 8. The terms intermittent, persistent and constant (as defined in Table 8) help differentiate between early and late stage 2, and stage 3.

47 To separate early and late stage 2 vascular, the terms occasional and frequent are used in Table 8 in conjunction with the Griffin blanching scores. If there is a mismatch between frequency of attacks and extent of finger blanching then the extent of blanching should be given more weight. This scheme is indicative. In some individual cases, occupational health professionals may need to use their professional judgement to allocate the individual to early or late stage 2.

48 The implications of future hand-arm vibration exposure following diagnosis of HAVS should be discussed with the employee. This discussion should include balancing the risk of disease progression whilst remaining in a role necessitating vibrating tool use. The available methods for assessment and prediction of progression of HAVS are not necessarily precise, with clinical judgment being required. However, the ability to handle a tool safely whilst experiencing vascular and/or neurological symptoms should be considered as part of the assessment process, as a recommendation of 'not fit for work' may need to be made on safety grounds.

Appendix 9 Sample questionnaires

Initial screening questionnaire

MEDICAL-IN-CONFIDENCE

INITIAL SCREENING QUESTIONNAIRE FOR WORKERS USING HAND-HELD VIBRATING TOOLS, HAND-GUIDED VIBRATING MACHINES AND HAND-FED VIBRATING MACHINES

Date: .....

Employee name: .....

Occupation: .....

Address: .....

Date of birth: .....

National Insurance no: .....

Employer name: .....

Have you ever used hand-held vibrating tools, machines or hand-fed processes in your job? Y/N

If YES:

(a) List year of first exposure .....

(b) When was the last time you used them? .....

(Detail work history overleaf)

1 Do you have any tingling of the fingers lasting more than 20 minutes after using vibrating equipment? Y/N

2 Do you have tingling of the fingers at any other time? Y/N

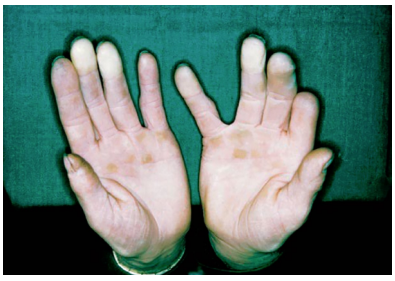
3 Do you wake at night with pain, tingling, or numbness in your hand or wrist? Y/N

4 Do one or more of your fingers go numb more than 20 minutes after using vibrating equipment? Y/N

5 Have your fingers gone white* on cold exposure? Y/N

*Whiteness means a clear discoloration of the fingers with a sharp edge (blanching), usually followed by a red flush

Blanching



6 If YES to 5, do you have difficulty rewarming them when leaving the cold? Y/N

7 Do your fingers go white at any other time? Y/N

8 Are you experiencing any other problems with the muscles or joints of the hands or arms? Y/N

9 Do you have difficulty picking up very small objects, eg screws or buttons, or opening tight jars? Y/N

10 Have you ever been told that you have circulation or nerve problems in your hands, eg hand-arm vibration syndrome, carpal tunnel syndrome or Raynaud's disease? Y/N

11 Have you ever had a neck, arm or hand injury or operation? Y/N

If so, give details: .....

12 Have you ever had any serious diseases of joints, skin, nerves, heart or blood vessels? Y/N

If so, give details: .....

13 Are you on any long-term medication? Y/N

If so, give details: .....

OCCUPATIONAL HISTORY

Dates Job title

I certify that all the answers given above are true to the best of my knowledge and belief.

Signed: ..... Date: .....

RETURN IN CONFIDENCE TO:

.....

Annual screening questionnaire for health surveillance

SCREENING QUESTIONNAIRE FOR WORKERS USING HAND-HELD VIBRATING TOOLS, HAND-GUIDED VIBRATING MACHINES AND HAND-FED VIBRATING MACHINES

Date: .....

Employee name: .....

Occupation: .....

Address: .....

Date of birth: .....

National Insurance no: .....

Employer name: .....

Date of previous screening: .....

Have you been using hand-held vibrating tools, machines or hand-fed processes in your job, or if this is a review, since your last assessment? Y/N
(Detail work history overleaf)

If NO, or more than 2 years since last exposure, please return the form – there is no need to answer further questions.

If YES:

1 Do you have numbness or tingling of the fingers lasting more than 20 minutes after using vibrating equipment? Y/N

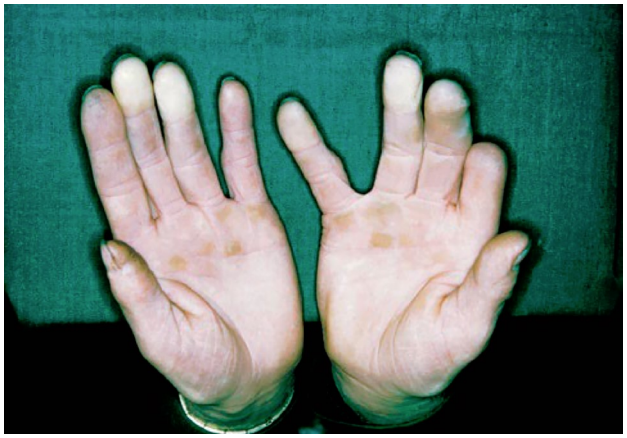
2 Do you have numbness or tingling of the fingers at any other time? Y/N

3 Do you wake at night with pain, tingling, or numbness in your hand or wrist? Y/N

4 Have any of your fingers gone white* on cold exposure? Y/N

*Whiteness means a clear discoloration of the fingers with a sharp edge (blanching), usually followed by a red flush.

Blanching



5 Have you noticed any change in your response to your tolerance of working outdoors in the cold? Y/N

6 Are you experiencing any other problems in your hands or arms? Y/N

7 Do you have difficulty picking up very small objects, eg screws or buttons, or opening tight jars? Y/N

8 Has anything changed about your health since the last assessment? Y/N

OCCUPATIONAL HISTORY

Dates Job title

I certify that all the answers given above are true to the best of my knowledge and belief.

Signed: ..... Date: .....
RETURN IN CONFIDENCE TO:

.....

Hand-arm vibration syndrome (HAVS):

- is a disorder which affects the blood vessels, nerves, muscles and joints of the hand, wrist and arm;
- can become severely disabling if ignored;
- in its best-known form is vibration white finger (VWF) which can be triggered by cold or wet weather and can cause severe pain in the affected fingers.

Signs to look out for in hand-arm vibration syndrome:

- tingling and numbness in the fingers;
- in the cold and wet, fingers go white, and sometimes then blue, then red and are painful;
- you can't feel things with your fingers;
- pain, tingling or numbness in your hands, wrists and arms;
- loss of strength in hands.

Clinical questionnaire

MEDICAL-IN-CONFIDENCE HEALTH SURVEILLANCE QUESTIONNAIRE
ASSESSMENT OF HAND-ARM VIBRATION SYNDROME

DATE

Mr/Mrs/Miss/Ms SURNAME FORENAMES

ADDRESS

POSTCODE

DATE OF BIRTH

OCCUPATION EMPLOYER

OCCUPATIONAL HISTORY

Right-handed ☐ Left-handed ☐ Leading hand: Right ☐ Left ☐

When did you first start using vibrating tools or equipment? Year

If you no longer use vibrating tools, when did you stop? Year

Which of the main elements of your present job involve use of vibrating tools or equipment and how much time per day ('trigger' or contact time)?

	Hours/day	Years
(a)		
(b)		
(c)		
(d)		

When did you join the company?

.....

List main jobs and departments in chronological order, together with the time you spent working there (in years):

	Hours/day	Years
(a)		
(b)		
(c)		
(d)		

What jobs did you do previously, outside this company, involving vibration?

	Hours/day	Years
(a)		
(b)		
(c)		
(d)		

	Yes	No
Have you had any exposure to chemicals at work?		

If YES, give details:

GENERAL PRACTITIONER'S ADDRESS .....

.....

HAND SYMPTOMS

Blanching	Yes	No
Have you ever suffered from your fingers going white? If NO, go to the section on tingling symptoms		

If YES (and still occurring in the last 2 years), does it occur:

	Yes	No
In response to cold, damp or wet conditions?		
While working?		
At other times?		

Please give examples:

When did you first notice this whiteness? Year .....

How often does it occur:	Yes	No
Several times a year?		
Several times a month?		
Several times a day?		
Every day?		
Does it occur in winter only?		
Winter and summer?		

State most common circumstances:

	Yes	No
Do you experience whiteness in your feet or other periphery?		

If YES, state where:

Which fingers are affected? (Shade all parts that have ever gone white)

Right hand



Left hand



Photograph of blanching seen? Y/N

Tingling (excluding transient tingling lasting for up to 20 minutes after using vibrating tools)

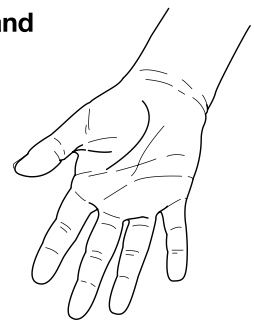
	Yes	No
Do you have tingling of the fingers?		
In response to cold?		
With blanching?		
While working?		
At other times?		

If at other times, under what circumstances, and how long does it last?

When did you first notice this? Year .....

Which fingers are affected? (Shade all affected parts)

Right hand



Left hand



Numbness (excluding transient numbness lasting up to 20 minutes after using vibrating tools)

Do your fingers go numb:	Yes	No
In response to cold?		
With blanching?		
While working?		
At other times?		

If at other times, under what circumstances, and how long does it last?

When did you first notice this? Year .....

Which fingers are affected? (Shade all affected parts)

Right hand



Left hand



	Yes	No
Do you have difficulty handling or manipulating small objects? If YES, when does this occur?		

	Yes	No
Do any of these symptoms (blanching, tingling or numbness) affect your work or leisure activities?		

If YES, give details:

Musculoskeletal

	Yes	No
Are you experiencing problems with the muscles or joints of your hands/arms/wrists/elbows/shoulders?		
Pain?		
Stiffness?		
Swelling?		
Weakness?		

If YES, give details:

SOCIAL HISTORY/LEISURE PURSUITS

	Yes	No
Do any of your hobbies expose you to hand-arm vibration?	☐	☐

If YES, give details:

Are you a smoker? ☐ Non-smoker? ☐ Ex-smoker? ☐

If smoker, how many do you smoke each day? /day

If ex-smoker, when did you stop? .....

	Yes	No
Do you drink alcohol?	☐	☐

If YES, how many units per week? ..... units/week

MEDICAL HISTORY

	Yes	No
Do other members of your family suffer from white finger? (Include brothers, sisters and parents only)	☐	☐

If so, who?

	Yes	No
Have you ever had a neck/arm/hand injury or operation?	☐	☐

If so, what and when?

	Yes	No
Were you left with any problems?	☐	☐

If so, what?

Have you ever had any serious disease of:

	Yes	No
Joints?		
Skin?		
Nerves?		
Heart or blood vessels?		
Other?		

If so, give details:

	Yes	No
Are you on any long-term medication or treatment for any condition?		

If so, give details:

EXAMINATION

Time since last exposure to vibration (years, months, days or hours):

Room temperature °C

Appearance of hands (Note any signs of vascular disease, deformity, scars, callosities or muscle wasting)

Right hand



Left hand



Circulation

Pulse rate (bpm)		Blood pressure (mm Hg)	
Right		Right	
Left		Left	

		Present	Absent		Present	Absent
Radial pulse	Right			Left		
Ulnar pulse	Right			Left		

		Positive	Negative		Positive	Negative
Allen test	Right			Left		

Nervous system

		Normal	Abnormal		Normal	Abnormal
Monofilaments	Right			Left		
Manual dexterity (Purdue pegboard test)	Right			Left		

Further tests, where appropriate

Adson's test	Right			Left		
Tinel's test	Right			Left		
Phalen's test	Right			Left		

Musculoskeletal

Describe any abnormality of neck or upper limbs: .....

.....

	Right	**Left**
Grip strength (in kg)		

ASSESSMENT OF HISTORY AND EXAMINATION

Vascular	**Yes**	**No**
Primary Raynaud's disease?		
Secondary Raynaud's phenomenon?		
If so, is this vibration-induced?		

	Right	**Left**
Modified Stockholm vascular grading		

Neurological	**Yes**	**No**
Neurological impairment suggested by clinical assessment?		

	Right	**Left**
Modified Stockholm sensorineural grading		

	Yes	**No**
Is carpal tunnel syndrome suggested by history and findings?		

Musculoskeletal	**Yes**	**No**
Musculoskeletal disorder present?		

If musculoskeletal disorder present, please specify

.....

	Yes	**No**
Further special investigations required?		

Results

Outcome of special investigations

	Yes	No
Fit for work with exposure to hand-transmitted vibration?	☐	☐

Any conditions or vibration restrictions to be followed?

Date for next assessment .....

	Yes	No
Has advisory leaflet been given to employee?	☐	☐

Additional comments:

Signature: .....

Date: .....

Acknowledgement
HSE acknowledges the contribution of the Working Group on Hand-transmitted Vibration of the Faculty of Occupational Medicine of the Royal College of Physicians and the medical assessment process of the Department for Business, Energy & Industrial Strategy.

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Note: For dated standards, only the edition cited applies. For undated standards, the latest edition of the referenced document (including any amendments) applies.

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Further information

For information about health and safety visit https://books.hse.gov.uk or http://www.hse.gov.uk. You can view HSE guidance online and order priced publications from the website. HSE priced publications are also available from bookshops.

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Statutory Instruments can be viewed free of charge at www.legislation.gov.uk where you can also search for changes to legislation.

For information about European harmonised standards visit: http://ec.europa.eu/growth/single-market/european-standards/harmonised-standards/machinery/index_en.htm

HSE's vibration webpages: www.hse.gov.uk/vibration

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