



WHITEPAPER

THE IMPACT OF VIBRATION ON CONSTRUCTION SITE OPERATIVES

FOREWORD

Just as extended exposure to dust causes all manner of respiratory illnesses operating industrial tools and equipment has its own long term risks. By far the most common is Hand-Arm Vibration Syndrome (HAVS).

In recent years (HAVs) has become one of the most important occupational diseases in terms of incidence, health and safety enforcement and compensation for workers.

This white paper clearly explains the statutory framework – including the risk assessment and health-surveillance requirements of the legislation and practical measures that can be implemented to address the health implications of occupational exposure to vibration.

It will be a valuable resource for all industry professionals dealing with HAVs, whether occupational health, hygiene and safety practitioners, legal advisers or managers.

Remember, when using tools that vibrate are the only option, you must monitor your worker's use of the equipment by strictly adhering to time limits, which can be harmful to health when overused and not managed effectively.

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Veritas Consulting is a specialist consultancy providing Health and Safety and CDM advice. The company supports, consults and coaches construction and the built environment industry professionals across the UK.

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ABOUT MILWAUKEE

Milwaukee Electric Tool Corp. is an industry-leading manufacturer and marketer of heavy-duty, portable electric power tools and accessories for professional users worldwide.

Since its founding in 1924, Milwaukee has focused on a single vision: To produce the best heavy-duty electric power tools and accessories available to the professional user. Today, the Milwaukee name stands for the highest quality, durable and reliable professional tools money can buy.

Milwaukee currently employs approximately 1,000 people globally. The company continues to set industry standards, targeting professional tool users of all types with a product line that includes more than 500 tools and over 3,500 accessories. Throughout its history Milwaukee's commitment to quality remains steadfast, although the way that quality is ensured has changed drastically. Quality is designed in, using state-of-the-art technologies and sophisticated manufacturing techniques.

The people at Milwaukee are as much a part of the success as the tools themselves. All of Milwaukee's tool and accessory manufacturing operations have been arranged in manufacturing cells consisting of teams of motivated and empowered employees. Cellular manufacturing methods help Milwaukee employees focus on customer needs; allow for quick response to market demands; and increase employee productivity and product quality.



INTRODUCTION

The European Agency for Safety and Health at work (OSHA) estimates that up to 600 million working days are lost across the EU each year with other associated issues such as strains and musculoskeletal injuries included which are known to be caused by excessive vibration:

 osha.europa.eu/en/publications/factsheets/3

It is estimated by the UK Health and Safety Executive (HSE) that up to 300,000 working days are lost each year in Britain due to hand-arm disability related absences. These injuries are known as 'hand arm vibration syndrome' (HAV) most commonly caused by power tools.

 www.hsl.gov.uk/what-we-do/noise-vibration

In general terms all manufacturers are required to state vibration emissions under current ISO regulations and employers are encouraged to buy from those companies with the lowest rates. Vibration emissions are under constant review and it may be that manufacturers need to be more proactive in this area in the future.

It should also be noted that independent research by Loughborough University in the UK suggests that manufacturers are underestimating levels of vibration. This is discussed later in this document under the heading Declared Emission Values.



LEGISLATION AND REGULATIONS

EUROPE

The European Physical Agents (Vibration) Directive (2002/44/EC) deals with risks from vibration at work and is one of several Directives dealing with physical agents such as noise and vibration. They do not apply to members of the public exposed to vibration from non-work activities.

The Control of Vibration at Work Regulations (2005) require more specific duties compared to earlier general health and safety regulations such as the Management of Health and Safety at Work Regulations (1999) which still apply.

The vibration directive (2002/44/EC) (1) introduces minimum protection requirements for workers when they are exposed to risks arising from vibration.

 osha.europa.eu/en/legislation/directives/19

National measures to enforce the directive have been taken by all 26 Member States since it came into force across Europe on 6th July 2005. It provides an overview of the challenges facing the occupational safety and health (OSH) community.

In general terms the provisions of the EU directive is taken as a starting criterion in all national legislation. In some countries, however, national law has set stricter requirements than those of the directive and other countries have adopted different approaches. For example:

- Finland and Poland have fixed short-term exposure limit values and Germany has an exposure limit value of 0.8 m/s² for vertical axis whole-body vibration.

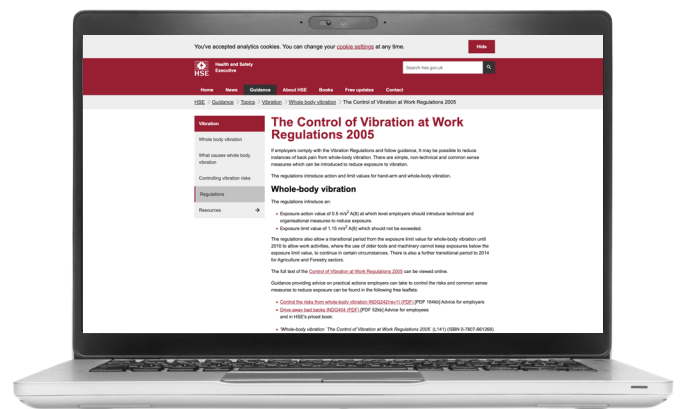
- Across Europe it would seem that few employers actually take vibration measurements (approximately 5% in Finland) and many do not even evaluate the risk (around 55% in Belgium).
- Evaluation is usually based on data provided by the equipment manufacturer or obtained from online databases.
- In order to assist employers with their risk evaluation, some countries (e.g. Poland, Spain) have trained many laboratories in how to carry out measurement of vibration, while other countries have favoured the management of risks by users themselves (Belgium).
- Overall, the number of accredited organisations in the field of vibration assessment is still small whatever the country.



UK

In the UK, the Control of Vibration at Work Regulations (2005) are guided by a European Union Directive requiring similar basic laws throughout the Union on protecting workers from risks to their health and safety from vibration.

 www.hse.gov.uk/vibration/wbv/regulations.htm

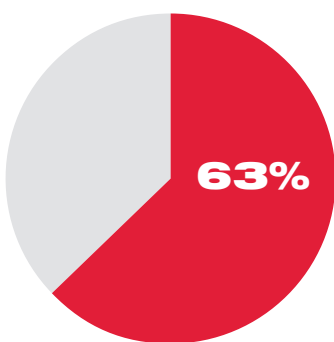
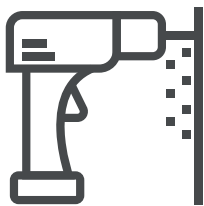


VIBRATION INJURIES

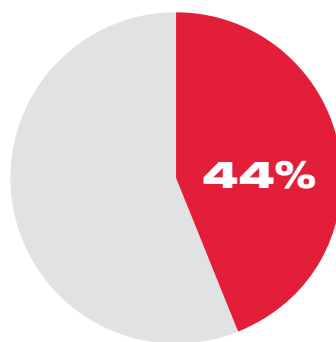
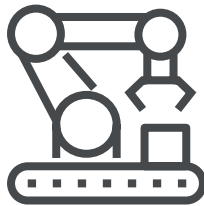
Vibration exposure is mainly accounted for by rotative tools (grinders, saws, etc.), of which there are estimated to be 4.5 million in use in Germany and 200,000 in Finland. The estimations for percussive (chipping hammers, breakers, etc.) and roto-percussive (perforators, etc.) tools are 600,000 for Germany and 70,000 for Finland. There are no figures available for other countries.

Workers exposed to vibration are overwhelmingly male and typically either drivers of mobile machines, operators of hand-tools, or people working in the vicinity of stationary machines. The proportion of the workforce exposed to vibration varies widely between countries, from 14% to 34%, and is concentrated in the sectors of:

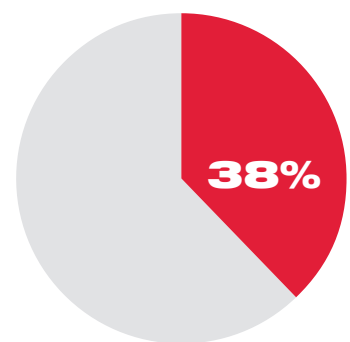
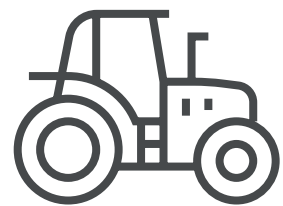
CONSTRUCTION



MANUFACTURE AND MINING



AGRICULTURE AND FISHING



Much of the research in both the EU and UK also includes other types of machinery known to cause vibration. Because of this vibration injuries are classified in two ways – HAV (Hand Arm Vibration) which occurs where vibrating tools or equipment are gripped by the hand and WBV (Whole Body Vibration) which occurs where the body is supported by a vibrating surface such

as heavy plant – this should be considered when looking at figures.

However, even though these and the other statistics which follow include many different causes, it is clear that vibration is a major source of injury and days lost at work.



A. WBV (WHOLE BODY VIBRATION).

With respect to whole-body vibration (WBV), it is estimated that the action levels established in the directive will be exceeded by operators of most off-road machinery and agricultural and forestry tractors when travel is frequent. We understand that this does not directly impact heavy duty power tool manufacturers but has to be considered in the context of vibration statistics and legislation across Europe.



B. HAV (HAND ARM VIBRATION)

As in the case of the UK, European countries claim that hand-arm vibration (HAV), will be exceeded by operators using:

- Most main percussive and roto-percussive tools such as chipping hammer, demolition hammer, rock drill, breaker, impact drill, scabbler, rammer, vibratory rammer.
- Main rotative tools such as grinder, impact wrench, sander.
- Main alternative tools such as jig-saw, file.

European legislators suggest that the limit value for exposure to (HAV) vibration may be exceeded if percussive and roto-percussive tools are used for more than one to two hours a day, or in the case of some rotative tools, if used for more than four hours.

THE SITUATION IN THE UK

What Is Safe?

The Health and Safety Executive (HSE) in the UK is now encouraging employers to use a points system to assess how long staff should be using power tools. There is also a level of vibration exposure that must not be exceeded. This is called the Exposure Limit Value.

It is limited to 400 points, the maximum exposure, and it legally cannot be exceeded each day. It works by giving each tool a number of points per hour based on the type of tool and can be used in helping Milwaukee provide guidance to customers as to how long a person should work with each product.

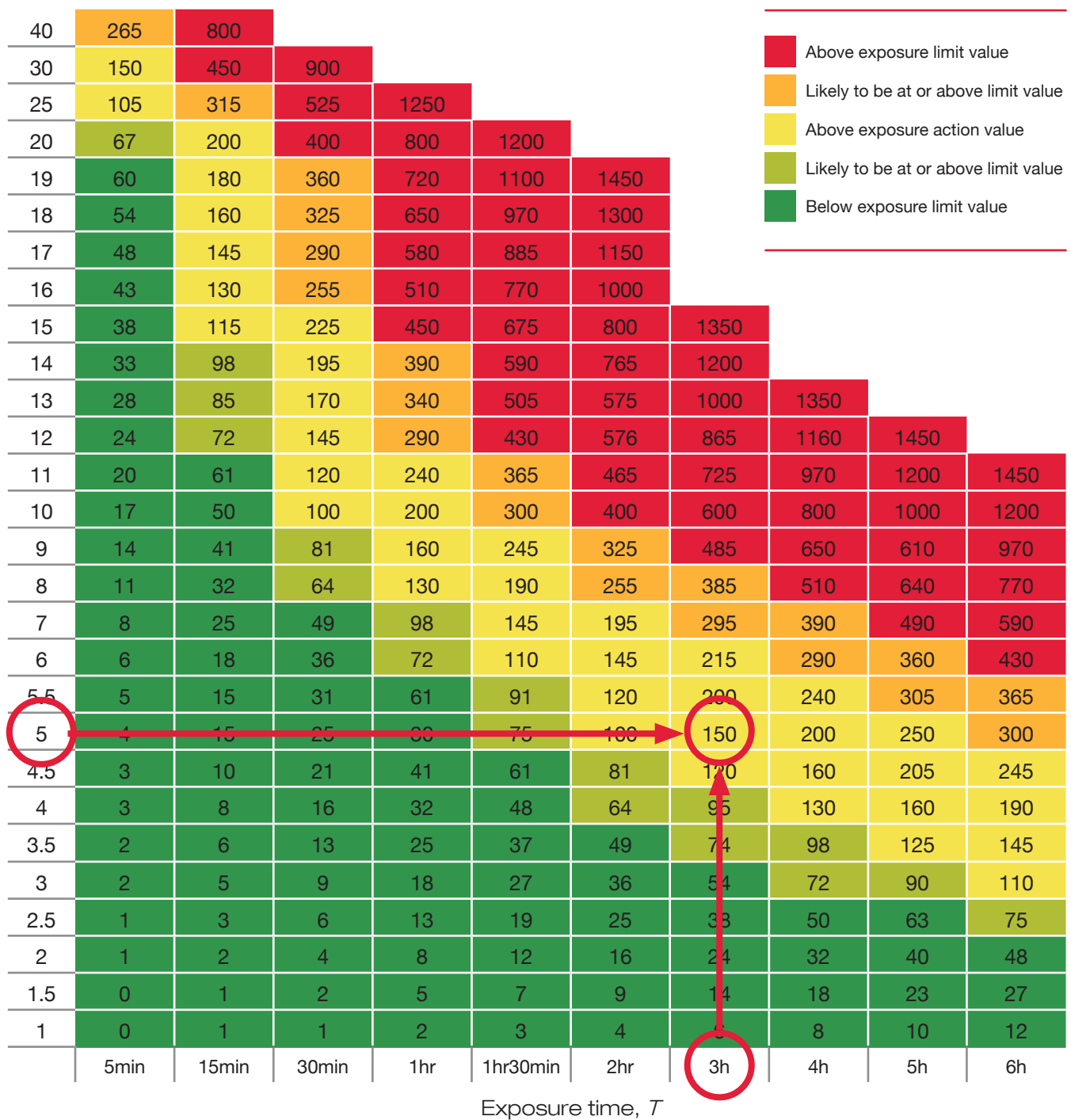
 www.hse.gov.uk/vibration/hav/readyreckoner.htm

What follows is HSE's ready reckoner and how it works:

- a. Find the vibration magnitude (level) for the tool or process (or the nearest value) on the grey scale on the left of the table.
- b. Find the exposure time (or the nearest value) on the grey scale across the bottom of the table
- c. Find the value in the table that lines up with the magnitude and time. The illustration 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.
- d. 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 exposure action value. The colour of the square containing the exposure points value tells you whether the exposure exceeds, or is likely to exceed, the exposure action or limit value.
- e. If a worker is exposed to more than one tool or process during the day, repeat steps 1 – 3 for each one, add the points, and compare the total with the exposure action value (100) and the exposure limit value (400).

The Vibration Regulations in the UK require employers to:

- Make sure that risks from vibration are controlled.
- Provide information, instruction and training to employees on the risks of vibration.
- Provide suitable health surveillance. The Vibration Regulations include an exposure action value (EAV) and an exposure limit value (ELV) based on a combination of the vibration at the grip point(s) on the equipment or work-piece and the time spent gripping it. (See table in previous section)
- Duties are to reduce the risks from vibration to the lowest level that is reasonably practicable and to reduce exposure to as low as is reasonably practicable if it is above the EAV.
- Employers must not allow exposures to exceed the ELV. They must comply with the Vibration Regulations to prevent disability from HAVS and vibration-related CTS.
- Health surveillance should identify any harm early on, so appropriate action can be taken to prevent disability.



REDUCING THE RISK

a. Vibration Damage Times

HSE has noted that in some industries, assessment will often show that the operating time of equipment before it causes vibration damage is actually very short and more care needs to be taken to ensure that the exposure action value (EAV) is not exceeded.

Projects involving regular and frequent exposure to vibration above the EAV are found in a wide range of industries, such as:

- Construction and civil work
- Engineering
- Forestry
- Foundries
- Motor vehicle manufacture and repair
- Maintenance of parks, gardens, verges, grounds etc
- Shipbuilding and ship repair
- Utilities (e.g. gas, water, telecommunications).

b. Tools with the greatest risk

HSE investigation has shown the following tools deliver the highest risk:

- Chainsaws
- Grinders (all types and sizes, e.g. angle, die, straight, vertical etc)
- Hand-fed equipment, e.g. pedestal finishers, grinders, mops; impact drills
- Scaling hammers including needle scalers
- Pedestrian controlled equipment including mowers, floor saws, floor polishers
- Powered hammers for chipping, demolition, road breaking etc.
- Sanders and polishers
- Hand-held saws for concrete, metal, ground clearance etc.

c. Guidance on time limits

These are recommendations from the HSE for time limits broken down by type of power tool. They apply to powered hand-tools and are based on regular and frequent use.

Result in exposure at or above the EAV is as follows:

- The use of a hammer action tool for about 15 minutes
- The use of non-hammer action tools for about one hour.

d. Tools that create vibration

According to HSE advice, manufacturers and suppliers have duties under the Supply of Machinery (Safety) Regulations Act to provide health and safety information in equipment handbooks.

 www.legislation.gov.uk/ukxi/2008/1597/contents/made

Manufacturers also have a duty to list the vibration emissions in literature describing equipment performance. This should be, but is not always, suitable for estimating vibration exposure.

HSE also insists that manufacturers supply all of the following information:

- Warning of any vibration-related risks from using the equipment.
- Information on safe use and, where necessary, training requirements.
- Information on how to maintain the equipment.
- Information on the vibration emission of the equipment.

ACTIONS TO BE TAKEN

Health and Safety actively advises employers to consider all vibration emissions before purchasing or hiring power tools. Longer term this could have repercussions or opportunities for those manufacturers that cannot manufacture product with reduced vibration capability. In the short term HSE is advising employers to avoid power tools with high vibration emissions.

You can find vibration information and good practice examples of vibration control at  www.hse.gov.uk/vibration

In broad terms guidance is as follows:



Look for ways of working that avoid or reduce the need to hold vibrating equipment or work-pieces.



Consider vibration emissions when purchasing or hiring equipment, for example: check the vibration of available equipment in technical sales literature or handbooks.



Avoid types with high vibration when there are suitable lower vibration alternatives.



Keep an inventory of equipment and its vibration emission.



Maintain equipment in accordance with its manufacturer's instructions.



Plan work schedules to minimise vibration exposures and make sure exposures are below the ELV.



Organise work and design workstations to avoid uncomfortable postures and the need for high manual effort to grip, push or pull equipment.



Help employees maintain good blood circulation, for example, by providing clothing to help them keep warm and dry.

DECLARED EMISSION VALUES

As this report shows the onus is very much on the employer as opposed to the manufacturer to ensure that vibration emissions are enforced.

Manufacturers' declared vibration emission values are usually obtained according to harmonised European vibration test codes produced by European or international standards bodies.

EN ISO 20643:2005 provides the basis for the drafting of vibration test codes for hand-held and hand-guided power-driven machinery. Examples of these codes are the EN ISO 8662 series for pneumatic and other non-electric tools and the EN 60745 series for electric tools.

Declared emission values allow purchasers to compare machines tested to the same standardised test code. They can show up large differences between machines, allowing high-vibration tools to be avoided.

Emission data from manufacturers can also indicate how much vibration is likely to enter a person's hands when using a particular power tool. This may be useful to help make an estimate of daily exposure and an assessment of the risk.

Independent research has been undertaken for this by Loughborough University and can be accessed via:

 <https://core.ac.uk/download/pdf/288387304.pdf>

Their research shows that their findings are substantially different to those of manufacturers who have not been named. We recommend a full read of this research, but here is one very salient paragraph:

In terms of tool types, it was found that the estimation error for the declared data was: sanders (-3.7%), grinders - after multiplication factors (-8.3%), battery powered drills (-8.8%), breakers (-12.5%), saws (-18.2%), hammer drills (-18.6%) and diamond core drills (-58.5%).

If legislation is tightened up in this area at some time in the future it is possible that manufacturers may have to explain these perceived differences.

CASE STUDY: LOREM IPSUM

INTRODUCTION

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FURTHER INFORMATION

More detailed guidance on controlling vibration risks is available.

- Control of Vibration at Work Regulations 2005.

 www.hse.gov.uk/vibration/hav/regulations.htm

- Guidance on Regulations L140 HSE Books 2005 ISBN 978 0 7176 6125 1

 www.hse.gov.uk/pubns/books/l140.htm

- Consulting workers on health and safety. Safety Representatives and Safety Committees Regulations 1977 (as amended) and Health and Safety (Consultation with Employees) Regulations 1996 (as amended). Approved Codes of Practice and guidance L146 HSE Books 2012 ISBN 978 0 7176 6461 0

 www.hse.gov.uk/pubns/books/L146.htm
www.hse.gov.uk/riddor

CONCLUSION AND RECOMMENDATIONS

A key factor that emerges is that employees exposed to vibration should try to avoid unnecessarily high exposures by careful selection of power tools and other equipment.

This suggests that manufacturers who can eliminate or significantly reduce this risk are likely to be specified or used more frequently in the workplace. Government health and safety experts are actively encouraging this. Government advice also takes into account that it might

be better to use tools that are more efficient even if they deliver high levels of vibration as this will mean that exposure time might be reduced. This does suggest some level of trade off in this area.

As the onus to obey legislation is strictly on the employer it can only be assumed that heavy duty power tool manufacturers such as Milwaukee could profit by working more closely with employer groups.



milwaukeeetool.com