



LOCAL AUTHORITIES

Prevention Engineering for Hand Arm Vibration Syndrome
within Local Authorities.

ABSTRACT

Exposure to vibration can be difficult to predict and therefore difficult to control through risk assessment alone. This paper sets out to explain why HAVS continues to be a reason for skilled workers to be taken off the tools, as well as explain how technology can be used to manage your employees' exposure and prevent irreversible damage effectively and inexpensively.

Reactec Ltd

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Executive Summary

Hand-Arm Vibration Syndrome (HAVS) or vibration white finger is not a new industrial disease. Indeed, when regulations were released back in 2005 to control workers exposure to vibration at work, the HSE set a goal of eliminating the disease within 10 years. Fifteen years on and HAVS is still the highest reported industrial disease (outside of COVID-19).

This paper sets out to explain why, with the range and variety of work undertaken within local authorities from grounds maintenance to street works, and more, HAVS continues to be the reason for fines and personal liability claims. Fundamentally, exposure to vibration can be incredibly difficult to predict and therefore difficult to control through risk assessment alone and knowing that employees are following carefully constructed controls is an impossible task.

Having highlighted the factors which make HAVS exposure management difficult, the paper goes on to explain how technology, such as Reactec's, can be used to manage your employees' exposure and prevent irreversible damage effectively and inexpensively.

20 years of experience, collaborating with industry leaders, academia, and the HSE, has given Reactec unequalled understanding of HAVS as a condition and how the source of damage can be controlled. Whether your perspective is employee welfare or corporate compliance you can be assured that proven technology exists to meet your needs.

Immediate and long-term gains require a shift towards prevention rather than simply compliance; by measuring what's happening, you can tailor your controls faster, engineer out risk and actively protect your workers' health in the workplace.

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1. Introduction

Hand-Arm Vibration (HAV) is the term to describe exposure of the hands and arms to vibrating surfaces. It can be caused by operating hand-held power tools, such as hammer drills, breakers, hedge trimmers, chainsaws, pedestrian mowers, and even ride-on mowers, to name but a few.

Occasional exposure is unlikely to cause ill health. However, regular, and frequent exposure to HAV can lead to Hand-Arm Vibration Syndrome (HAVS) and Carpal Tunnel Syndrome (CTS).

Exposure to this type of vibration energy through the hand is known to cause irreversible damage to nerves, blood vessels, muscles, and bones. Once the damage is done it is permanent.

The HSE estimates that 2m people in the UK are at risk of developing HAVS due to their work.

2. Hand-Arm Vibration: Key Statistics in Local Authorities

Hand-arm vibration can be a significant health risk wherever hands are exposed to vibration for prolonged periods of time, and it is a common injury within Local Authority working environments.

Local authority workers are probably exposed to some of the greatest variability in terms of the work they undertake, and range of tools used. Within grounds work, tools range from passive trimmers and blowers, to powerful chainsaws and cutters, meaning the range of vibrations experienced is expansive, whilst terrain and seasonal factors introduce a wide range of factors that will influence an individual's exposure risk. Within street works, a very different set of tools come into play, sometimes with an added complication of emergency response factors.

£1 = £10

Every £1 recovered through insurance, costs a company £10 in uninsured costs
(HSE)

76%

There is a 76% underestimation from typical HAV exposure risk assessments of those most at risk
(Reactec Analytics data)

£0.25m

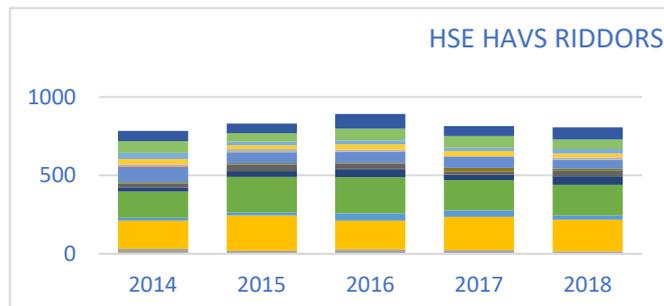
One Local Authority received a fine of £250,000 for multiple HAVS breaches
(HSE)

300%

300% rise in financial penalties relating to HAVS fines since new sentencing guidelines were introduced in 2016¹
(Hidden Threat Report)

No decline

In 2005, the HSE goal was to eliminate HAVS completely by 2015. Yet, HAVS RIDDORS are not declining:



3. How is HAVS Currently Managed?

Assessing your employees' risk of exposure to HAV is probably, in itself, an onerous task:

- **Risk Assessments:** how many different processes expose employees' hands to vibration and how often do these processes change, requiring a re-assessment of the risk?
- **Time in Motion Studies:** Are you sure that, for manual work with power tools, the time estimates are good? Do you track activity levels on tools?
- **Tool Testing:** How often, and for which of your tools, are tool tests routinely carried out? Do they reflect different uses of the tool? Is it often enough to capture a degrading tool?
- **Control Records:** How are controls developed, documented, or assessed for effectiveness?

4. Legal Obligations

The Control of Vibration at Work Regulations came into force on 6 July 2005 and aim to protect workers from risks to health from vibration. This regulation and associated guidance require the following:

- Elimination or control of vibration exposure risk to as low as reasonably practicable (ALARP).
- An assessment of the risks to employees from exposure to vibration, including assessment of employees' daily exposure to vibration.
- Information, instruction and training to tool users and their managers.
- Health surveillance when required.

A suitable and sufficient assessment of HAV exposure risk requires a determination of:

- **Duration** of exposure and
- **Probable vibration magnitude** during exposure.

As a regulation, it leaves two critical areas of judgement to be applied by a duty holder - areas of judgement that require either a significant investment to become a subject matter expert or consideration of technology to bring clarity to a daunting task:

- **What is a suitable and sufficient assessment of HAV risk?**
- **What is the probable vibration magnitude during tool use?**

5. Why Does HAVS Still Dominate RIDDORS?

The traditional method for carrying out a risk assessment of a worker's exposure to vibration could yield unrealistic, unrepresentative information because it relies on data from one person's use of *one* tool during *one* activity at *one* point in time. It doesn't account for the variability or unpredictability that most certainly influences an individual's actual, long-term exposure to vibration.

Therefore, it's important to understand all the factors, many of which are unpredictable, that affect a worker's exposure levels:

1. Does the risk assessment match the real tool use?
2. How representative is vibration data used for risk assessments?
3. Do you have inadequate or ineffective controls in place?

4. Operator competency – how well does each operator use the tool?
5. Operator compliance – are your operators following your controls such as work sharing?
6. Is the right tool being used for the job?
7. Tool condition – is the tool fit for the job?
8. What is the condition of the tool accessory?
9. What material is being worked on?

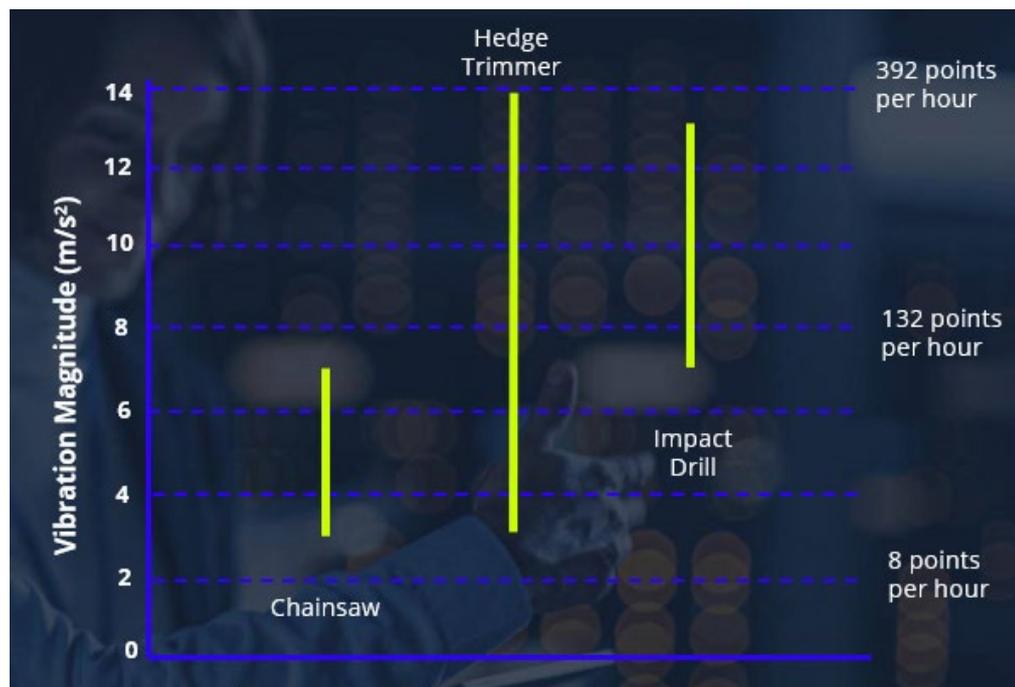
To illustrate just how impactful these factors can be, the HSE has published data on the possible range of vibration magnitude for typical tool types within a document titled sources of vibration magnitude dataⁱⁱ.

The data gathered from tool measurements carried out by the HSE laboratories in the field is tabulated showing the lower (10%) and upper (90%) percentile of vibration magnitudes measured. Graphed below is the range for three typical tools:

Hedge Trimmer: Higher vibration values are possible. Vibration values may be higher if the hedge trimmer often has to work hard to cut thicker branches.

Chainsaw: Good maintenance is important e.g., regular replacement of engine mounts and sharpening of saw points.

Impact Drill: this can give very high vibrations if operators push too hard. Maintaining sharp drill bits is important.



6. How Good Are Your Risk Assessments?

Even with the right training, it's hard to know just how closely everyone is following health and safety protocols. Individuals taking unanticipated risks, and unchecked exposure could damage your organisation down the line.

The challenge is how to accurately measure the problem. Manual methods, whether they be estimated tool time use or operator trigger time, can only ever be that - estimations. With considerable margins of uncertainty, operators deemed low risk could be exceeding exposure limits on a regular basis.

For example: The graphic below shows the results of a study conducted at a utility company to understand the effectiveness of a generic risk assessment of HAV exposure.

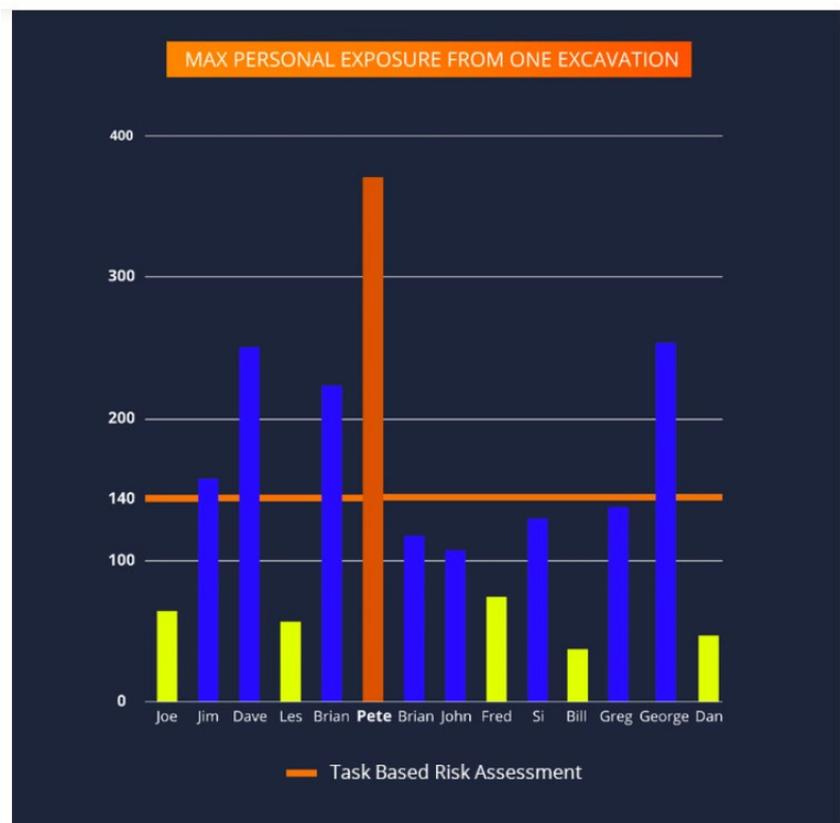
Several 2 and 3 worker teams were tasked with digging the same sized hole in the same type of road, with the same tool and with a typical control requiring the workers to work-share. Detailed measurements of trigger time and tool vibration magnitude were taken, with the task being repeated over ten times. The collected data was used to establish an average time of exposure and average vibration magnitude during exposure. With this data we established a task-based risk assessment that put the maximum individual exposure for a 2-worker team as 140 points, or less than the HSE EAV of 100 points if working in a 3-worker team.

However, the reality for the individuals in this exercise i.e., their individual measured maximum exposure from any one hole, is shown in the graphic. Five out of 14 individuals exceeded the risk assessment level and Pete approached the legal limit of exposure. Studying video footage from the exercise showed that Pete did not follow the work sharing control and his technique was such that he angled the tool into his body, resulting in less of the tool's energy being transferred into the road surface. This slowed the breaking process but also resulted in more of the tool's energy being transferred into his hands and body. A simple act with potentially grave consequences.

The utility company was astonished to see the results of their data; the potential result being that Pete is at considerable risk of developing HAVS, potentially within 6 years, if he continues to be exposed at this level which he experienced in just one excavation.

The effort and expense undertaken to conduct such a detailed risk assessment led to one stark conclusion - the task-based risk assessment did not reflect the workers' risk reality.

Immediate and long-term gains require a shift towards prevention rather than simply compliance. Measure what is happening, tailor your controls faster, engineer out risk and actively protect your workers' health in the workplace.



7. Do You Know How Competent Your Workers Are?

The following example is taken from an HSE published business case.ⁱⁱⁱ

A manufacturer of vibration-reduced pneumatic paving breakers made vibration measurements in real working conditions and found that the vibration exposures were highly dependent on the way the machines were operated.

It was found that untrained operators were exposed to vibration levels of about 9 m/s² and this was due to those operators not switching off the breaker before lifting it, therefore increasing the vibration. By further training the operators to stop the machine before moving it, as well as improving their technique whilst using the breaker, the average vibration was reduced to approximately 5.5 m/s².

In taking these steps, the trigger time to reach Exposure Action Value increased from 35 minutes to 100 minutes.

Not only did the training produce substantial reductions in the vibration exposures, but it also improved efficiency, leading to 17 times more output per day, without increasing vibration exposures.

More effective management of HAV exposure has a direct additional benefit of improved productivity.

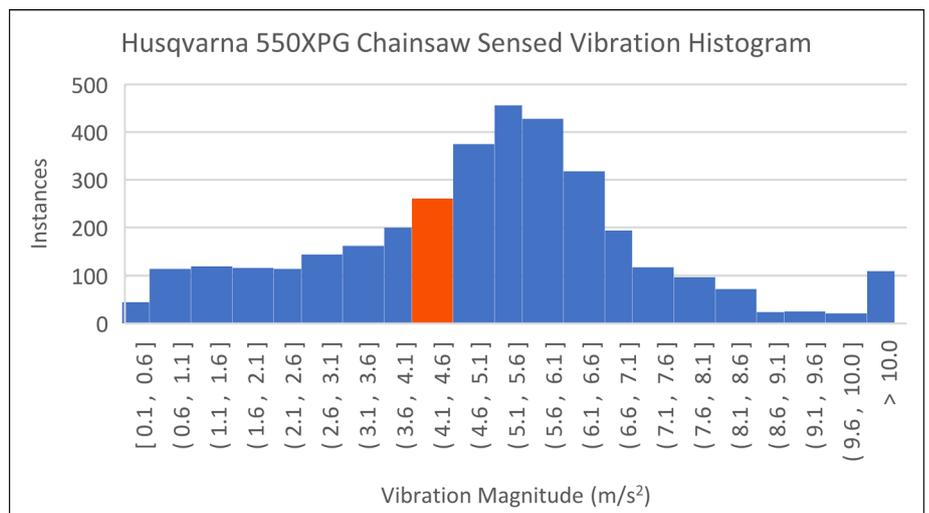
Through proper training, safe time on the tool was increased from 35 minutes to 100 minutes while operational output per day increased by a factor of 17.

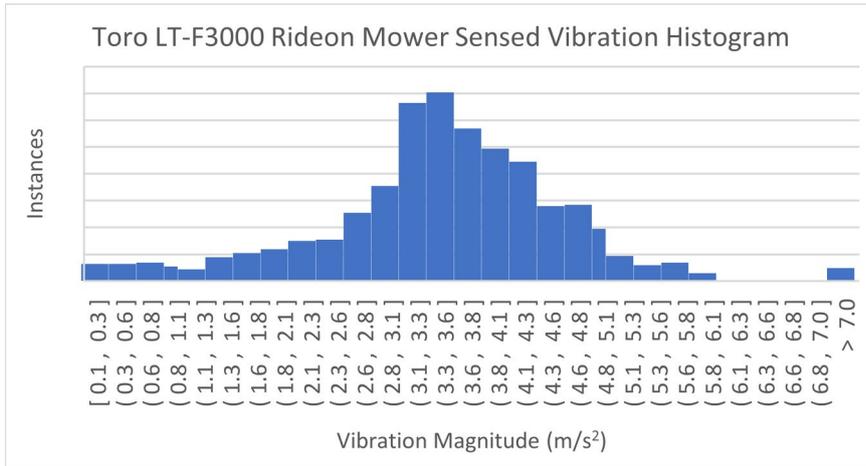
8. Top Tools Used within Local Authorities

The following histograms have been developed from a large data set within Reactec’s data base. Analysis of such a large data set allows a third dimension to be added to the data published by the HSE as shown in [Section 5](#). Reactec’s real use field data shows how frequently vibration levels from specific tools occurs i.e., at what level is the tool most likely to operate. Below shows data for four common tools:

Chainsaw:

1,058 trigger hours of data.
 Manufacturer declared:
 4.9m/s²
 Weighted average: 5.5m/s²
 HSE: 3 – 7m/s²





Ride-on Mower: 641 trigger hours of data

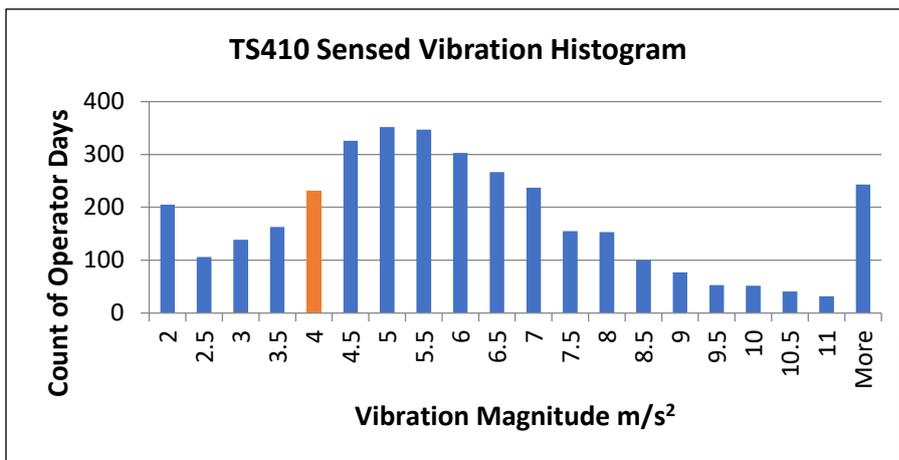
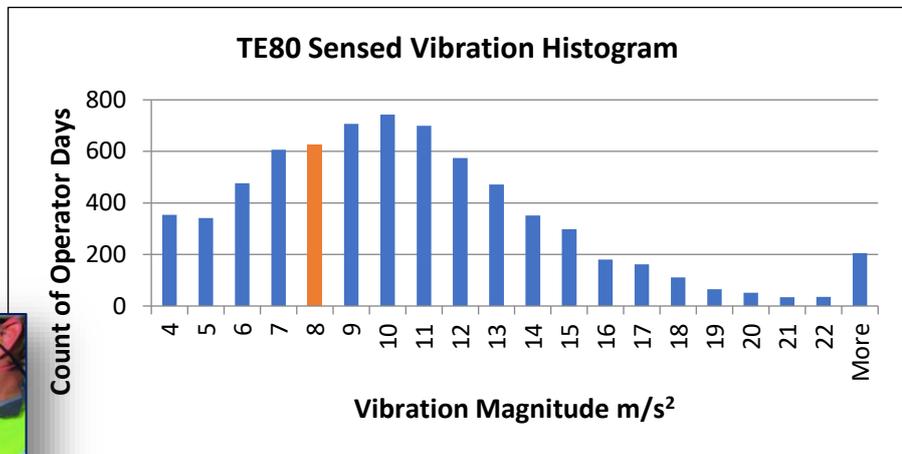
Manufacturer NOT declared:

Weighted average: 3.5m/s²

HSE: 3 to 6m/s²



Impact Drill: 4,811 trigger hours of data
 Manufacturer declared: 7.5 m/s²
 Weighted average: 11.2m/s²
 HSE: 7 to 13m/s²



Cut Off Saw: 1,755 trigger hours of data
 Manufacturer declared: 3.9 m/s²
 Weighted average: 6.1m/s²
 HSE: 5 to 14m/s²



9. Hand-Arm Vibration Prevention

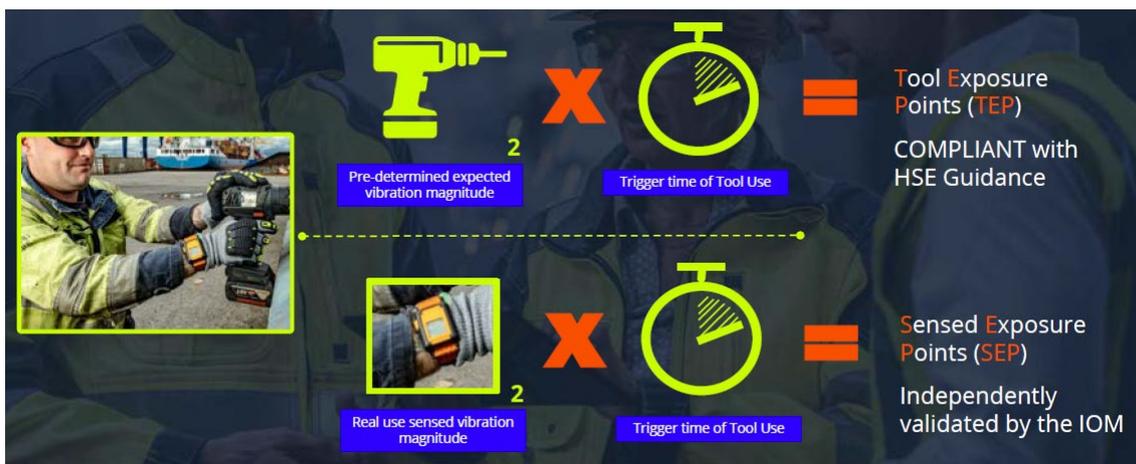
Exposure to this type of vibration energy through the hand is known to cause irreversible damage to nerves, blood vessels, muscles, and bones. Once the damage is done, it is permanent. However, HAVS is preventable and Reactec believe that, with the vast number of variables at play, only through the collection of real use data will you be adequately informed to properly prevent your employees developing this debilitating disease.

It is our view that risks can be better managed when they are measured. For over 20 years, we have seen our clients easily and quickly achieve compliance, whilst gaining absolute control of their operations and improve their productivity.

HAVWEAR from Reactec is a wearable device giving unique insight into individual exposure levels to Hand-Arm Vibration and personal alarms to directly influence behaviour.

More powerfully, combining the HAVWEAR with automatic data capture to the rich environment of the Reactec Analytics, all levels of management have enabling information at their fingertips, to effectively manage the HAV exposure of their workforce.

HAVWEAR provides two concurrent assessments of exposure to HAV- Tool Exposure Points (TEP) and Sensed Exposure Points (SEP) based on the measured trigger time of tool use and two alternate sources of vibration magnitude:



TEP is fully compliant with HSE Guidance, using a pre-defined expected vibration magnitude for the tool. Several sources can be used for this data including: a specific tool measurement carried out by an appropriately trained technician; using the HSE recommended 75th percentile of Appendix C; or applying a safety factor to manufacturer declared vibration magnitude.

SEP is based on a real use vibration magnitude measurement taken by a triaxial accelerometer within the device. Reactec use algorithms developed using the specialised equipment within the laboratories of NIOSH in the US, to compensate for the transmission through the hand and therefore approximate the real use vibration magnitude at the grip point of the hand.

Comparing the real use data of SEP with the expected data of TEP gives unprecedented insight to factors such as tool wear and worker technique.

The HAVWEAR watch informs the wearer of their exposure by calculating and displaying in real-time their HAV risk assessment exposure points or the time remaining for safe use of the tool. Sound and vibration alerts inform the wearer if their personalised exposure thresholds have been exceeded.

10. Is HAVWEAR SEP Representative?

The Institute of Occupational Medicine (IOM) - a globally recognised organisation focused on workplace health and safety - completed an in-depth, independent review of HAVWEAR.

The purpose of the IOM report was to study the suitability of the vibration magnitude data determined by HAVWEAR and whether the resulting Sensed Exposure Points (SEP) data is appropriate as a Risk Assessment / Risk Management tool.

The study was conducted in real tool use environments including Grounds Maintenance, Road Maintenance, Forestry, Metal Work, Workshop and Garage environments.

The results speak for themselves:

- **Suitable risk assessments:** The IOM found that the data generated by the HAVWEAR system provides a useful source of information to inform a suitable and sufficient risk assessment as the sensed vibration data is comparable with data collected by conventional means.
- **Risk reduction:** The HAVWEAR information gathered on a regular basis does inform the development of risk reduction control measures and can be used to identify trends in risk reduction.
- **Greater accuracy:** The IOM found that HAVWEAR may be more accurate than the use of trigger times and manufacturer's data or other data sources compiled for a limited range of tool activity.

[Access the full IOM report here](#)

11. Assessment/Monitoring vs Measuring: Approximately Right or Exactly Wrong

Significant confusion exists in the marketplace on what constitutes an appropriate measurement of HAV exposure. It should always be remembered that the legal requirement is to carry out **suitable and sufficient assessments** of exposure to HAV based on **the time of exposure and probable vibration magnitude**.

Obviously, and advised by the HSE in their L140 guidance, it is not always necessary to carry out a "measurement" of exposure to HAV. An ISO standard (ISO5349-2) exists for the "measurement" of exposure to HAV. This standard requires the use of an ISO8041 compliant instrument to take a measurement with an accelerometer firmly attached directly to the grip point of the tool within 10mm of the hand. The specific requirements of using these standards results in the need for a trained technician and for the measurements to be taken for very short periods of typically 1 minute. At best, some organisations may take three such measurements for the tool being used for one purpose once per year.

Again, rather obviously, the data obtained from an ISO compliant measurement is almost inevitably not accurate for the real and future use of that tool.

Hence "measurement" of HAV exposure is advised to be generally not necessary.

Several technologies have been developed with a different purpose to that of the ISO standards referenced above. These technologies are aimed at "monitoring" a worker's full working day, in an unsupervised manner, accumulating data from all the HAV exposure activities they undertake

across their working day. No device which can provide such data meets the detailed requirements of ISO5349-1(2) and ISO8041-1.

However, the HSE accepts the benefits of monitoring technologies to help inform risk assessments, to assess the effectiveness of controls and indeed to act as a control for high-risk employees. To use any monitoring technology, the HSE simply ask that the device captures the time of use of the tool and that the vibration magnitude data be representative.

12. Reactec Analytics

Reactec's Analytics software is the heart of Reactec's ecosystem and will help you turn exposure data into actionable intelligence. The intuitive analytics software is securely hosted on a robust and fully GDPR compliant cloud platform.

With a clearer understanding of the source and levels of exposure, the Reactec Analytics plays a central role in providing the most representative exposure assessment of risks and insight to enable employers to prioritise and mitigate risks – proactively at all levels and stages.

The platform allows you to easily share reports and alerts with all stakeholders via readily accessible online reports, which can also be auto emailed. Reports provide granular detail on tasks and tool usage such as:

- Highest risk tool by usage
- Highest risk operatives – average daily exposure
- Worker activity
- Operator competency – tool utilisation
- Tool condition – tool performance

Reactec Analytics provides clear and pertinent information to help prioritise efforts on the hierarchy of controls. It can support a company's continual risk reduction plan by allowing managers to add intervention notes, as well as log and track control measures against targets.

- **Record and monitor control measure success:** log applied control measures and track their effectiveness in reducing risk by the impact on workforce average daily HAV exposure.
- **Log and authenticate interventions:** log intervention notes allocated to individual employees and electronically sign to acknowledge.

13. Tool Use Training

Assigning a RASOR device will allow a roaming employee or supervisor to gather live HAV data from colleagues up to 30m away. This empowers supervisors to provide immediate interventions in the field to HAV alerts.

The RASOR also includes a tool training app which provides immediate feedback of risk levels during actual tool use. This allows managers/supervisors to train operators on their technique, grip, force, pressure etc, to help lessen their risk and improve productivity.



14. What Does the Industry Have to Say?



I would like to thank the Reactec team as we are now fully conversant in the capabilities of ensuring that our staff are monitored and processes reviewed to allow working practices to be amended and, in some cases, purchase new equipment that has less impact on the individual user, if required.

Doncaster Metropolitan Council

Daily monitoring has provided robust exposure data to support the defence of employee litigation of HAVS exposure on recent claims, where claimant payments have been considerably reduced.



Stirling Council



Nottingham City Council is a large and varied organisation with staff based all around the city. We needed a more accurate way of managing our vibration exposure levels, whilst keeping the methods straightforward and user friendly - Reactec has provided the solution.

"We can see that the data we are able to obtain will help us manage services and work activities in a much more sophisticated way than before. It also has the potential for additional benefits such as identifying business cases for tool purchasing and other workforce investments.

Nottingham City Council

15. Why You Should Invest in HAVWEAR: A Business Case

Collecting manual records of HAVS exposure is expensive and unproductive, costing around £400 per person per year. This is based on 5 minutes per worker per day to record, and 10 minutes per worker per week to administer. In addition, there is approximately 1 hour per manager per week checking these records.

The average liability claim per worker is £30,000 and HSE fines have increased threefold in recent years.



The cost per person of manual HAV exposure records is £1,152 compared to £451 when using HAVWEAR, across a three-year period. Investing in Reactec is lower cost and delivers data to help evidence compliance and drive productivity measures.

16. 20 Years' Experience: Our Journey

Reactec began back in 2001 as a spin-out from The University of Edinburgh.

In the early days as a consultancy, Reactec assembled a team of experts to specialise in understanding the impact of vibration on employees exposed to vibration as part of their everyday work.

That research eventually helped Reactec to develop the first tool for monitoring workers' exposure to HAV. That tool, the HAVmeter, was released in 2008 as a tool-mounted device and became the precursor to the wrist-worn HAVWEAR that is offered today.

Having successfully deployed this technology to over 100,000 workers to date - giving employees real-time feedback of their risk level and employers informative data on what is happening in the field - Reactec has seen risk levels materially reduce, and its technology has measurably improved customers' ability to refine and implement more effective risk reduction controls.

Reactec has seen how more relevant, more representative data can help prevent injury and damage to worker health, and that's why it remains committed to its mission of engineering risk out of the workplace.

Reactec is doing that by working to create a comprehensive ecosystem of workplace wearables for the Connected Worker: a community of products, technology and resources designed to provide workers and employers with the best data available for monitoring risk in the workplace, whether it be exposure to unsafe levels of vibration, noise or dust, proximity to dangerous tools, or the unique threats posed to lone workers.

Reactec began with a passion for understanding the impact of vibration on workers in heavy engineering and construction. That passion has grown steadily into an ambitious, important goal of enabling a workplace designed to prevent injury and damage to worker health, wherever, and however it may occur.



17. Reactec Credentials

With 20 years of experience behind us, over 100,000 UK operators are now supported by the Reactec system, helping over 1000 customers to manage and prevent workplace health risks. Our clients include over 100 Local Authorities, such as Doncaster Metropolitan Council, Stirling Council, Nottingham City Council, to name just a few.

All data management is GDPR compliant and is stored and transferred between devices in a robust and resilient way with the very latest encryption technologies. Both internally and with external authorities, we robustly and continuously validate the resilience and reliability of what we do.



Microsoft
Partner

Application Development
Application Integration

18. References

ⁱ [The Hidden Threat: why industry needs to go above and beyond in the fight against HAVS](#)

ⁱⁱ [HSE Sources of Magnitudes App 3](#)

ⁱⁱⁱ <https://www.hse.gov.uk/vibration/hav/campaign/construction/operatortraining.htm>