

Vibration exposure from nail guns and staplers

There are many health and safety risks associated with the use of nail guns and staplers (<https://www.hse.gov.uk/woodworking/nail-guns.htm>) all of which must be assessed, managed and reduced to as low as reasonably practicable.

These pages provide guidance on how to make an initial assessment of the daily vibration exposure from use of nail guns and staplers as part of a risk assessment to comply with the Control of Vibration at Work Regulations 2005.

Simple initial assessment

A simple estimate of daily vibration exposure from nail guns or staplers can be made if you know roughly how many fasteners an operator fires in a typical shift, and you can find the power tool manufacturer's declared vibration emission values. They should be given in the handbook as the magnitude (**a**) and the uncertainty (**K**), both in metres per second squared (m/s^2). You can then use these values in the calculator shown in Figure 1 to work out the number of daily exposure points:

**Vibration exposure from nail guns and staplers:
Calculator for use with manufacturer's data**

Number of fasteners per day	2000	
Manufacturer's a	4.5	m/s^2
Manufacturer's K	1.5	m/s^2
Daily Exposure*	2.7	$m/s^2 A(8)$
Daily Exposure points*	120	

*Colour coding is based on the *A(8) Daily Exposure* value $\pm 20\%$

KEY

- Likely to be below EAV
- Above or potentially above EAV
- Potentially above ELV

Tip: Use both the manufacturer's **a** and **K** vibration magnitudes from the handbook.

- If **a** is not given, use **a** = 5 m/s^2 ,
- if **K** is not given, use **K** = 2 m/s^2

Figure 1. Illustration of exposure calculator for nail guns and staplers.

This calculator can be downloaded here: ([insert link to calculator](#)).

How to estimate daily vibration exposure

To assess the vibration risk from any machine or power tool, the daily vibration exposure must be estimated and compared to the Exposure Action Value (EAV) and the Exposure Limit Value (ELV) in the Regulations to identify what control actions are necessary.

To estimate an operator's daily vibration exposure from the use of any power tool, you need estimates of:

1. the vibration magnitude (level) in m/s^2 , and
2. the daily exposure duration - the amount of time the operator is in contact with the actively vibrating surface.

For nail-guns and staplers, the number of fasteners per day can be used to estimate the effective exposure duration.

1. The vibration magnitude

HSE research (<https://www.hse.gov.uk/research/rrpdf/rr591.pdf>) showed that manufacturers' declared vibration magnitudes for nail guns and staplers corresponded well with vibration measured in real world situations **provided that the calculations took account of the number of fasteners fired within the vibration measurement duration.**

The manufacturer's declared vibration emission magnitude is given in terms of:

- the **a** value, the average vibration magnitude measured in the test, in m/s^2 ; and
- the **K** value, the uncertainty in the measurement, also in m/s^2 .

Manufacturers and suppliers of power tools are required to provide both the **a** and **K** values in the instruction manual.

For an initial assessment of the daily vibration exposure, the **a** and **K** values should be added together as shown in the worked example.

2. The daily exposure duration

For power tools such as grinders and sanders that operate continuously for periods of use it is fairly straightforward to understand and estimate the daily exposure time. However, for a nail gun or stapler, the time that the power tool is operating each time it fires is only a fraction of a second, and the pattern of use can be intermittent with bursts of activity separated by long gaps, so knowing how to assess the actual exposure time is complex. The key to assessing exposure is to make sure that the measure of exposure time corresponds to the way that the vibration magnitude has been measured.

In the manufacturers' tests to measure the declared vibration emission of a nail gun or stapler (e.g. ISO 28927-13), 10 fasteners are fired during each 30-second measurement period. The result is an average vibration value that represents the vibration from the tool when firing one fastener every 3 seconds, so the manufacturer's data represent the average magnitude over a 3 second period during which one fastener is fired. That is not to say that it takes 3 seconds to fire one fastener, only that the vibration produced when one fastener is fired is averaged out over 3 seconds.

If the manufacturer's declared vibration emission values, (**a+K**) are used for the assessment, the vibration value is effectively a 3-second-long measurement during which one fastener is fired. Therefore, when making a vibration exposure assessment using the declared vibration

values, the total daily exposure time should be estimated from the total number of fasteners fired in the shift multiplied by 3 seconds. This approach is illustrated in the worked example.

Note: Although an exposure duration assessed in this way may seem high when each firing is only a fraction of a second, it is appropriate for this approach to estimating daily vibration exposure, because of the way in which the vibration magnitude is measured (as described in the previous paragraphs).

Using the standard HSE vibration calculator to estimate vibration exposure from nail guns and staplers

The vibration magnitude (**a+K**, in m/s²) and the exposure time (in minutes) can be input to the standard HSE Hand-arm vibration exposure calculator to estimate daily vibration exposure: <https://www.hse.gov.uk/vibration/assets/docs/simple-hav.xlsx>

Worked example

An operator uses a nail gun to assemble fencing panels. Each panel requires an average of 100 nails and the operator usually produces 32 panels per shift.

The nail gun used has the following declared vibration values:

- **a** = 4.5 m/s²
- **K** = 1.5 m/s²

Calculations

- The **a+K** vibration magnitude is $4.5 + 1.5 = 6$ m/s².
- The total number of nails fired in a shift is $100 \times 32 = 3200$ nails per shift.
- The exposure duration to be used for the calculation is 3200×3 seconds = 9600 seconds, divided by 60 = 160 minutes.

Putting the two values (6 m/s², 160 minutes) into the HSE hand-arm vibration exposure calculator as shown in Figure 2, the daily vibration exposure for the operator is estimated to be around 3.5 m/s² A(8) or 192 exposure points.

Text Box 1

If using the standard HSE hand-arm vibration exposure calculator for nail gun or stapler vibration exposure estimates remember:

1. For the vibration magnitude: Use the tool manufacturer's declared **a** and **K** values added together. If no data is provided use **a** = 5 m/s² and **K** = 2 m/s²*
2. For the exposure duration: Use the number of nails or staples fired per shift multiplied by 3 seconds and then divide that answer by 60 (seconds) to get the number of minutes (exposure duration) to be entered into the calculator.

If the operator uses other power tools in addition to nail guns or staplers, the data for these tools (vibration magnitude and exposure time) can be included in the HSE hand-arm vibration exposure calculator to estimate the total daily vibration exposure for the operator from the combination of tools.

*This value reflects the mean plus 1 standard deviation of manufacturers' **a** and **K** declarations for a wide range of fastener driving tools obtained from an internet search by HSE in 2023/2024.



HAND-ARM VIBRATION EXPOSURE CALCULATOR

Version 6.3 September 2023

Company name/work area: _____

Employee ID and/or task name: _____

Tool Use drop-down list for HSE recommended initial tool magnitude value (range for tool shown in brackets) or manually add tool type and/or magnitude in this column and the Vibration magnitude in "User" column.	Vibration magnitude m/s ²		Task Points per hour	Time to reach EAV hh:mm	Time to reach ELV hh:mm	Exposure duration		Partial exposure m/s ² A(8)	Partial exposure Points
	HSE	User				hours	mins.		
Nail gun		6	72	1:23	5:33		160	3.5	192
INSTRUCTIONS: 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. Additional information such as company name, worker name may be added if printing or saving the calculation.								Daily exposure m/s ² A(8)	Daily exposure points
								3.5	192
								WARNING: Exposure at or above EAV (100 points)	
Exposure calculation by: _____								Calculation date: 06/08/2024	
Job role: _____									

Figure 2. Use of the standard HSE hand-arm vibration calculator

Typical exposure points values using the nail guns and staplers ready reckoner

The following ready reckoner table can be used to calculate the number of HSE exposure points for a known vibration magnitude and number of fasteners. Select the vibration magnitude on the vertical axis and the approximate number of nails or staples fired in a shift on the horizontal axis. Follow the two lines to where they meet to find an estimate of the number of exposure points per shift. The points values are additive, so if the number of fasteners you are looking for is not given on the horizontal axis, select values for the number of fasteners that add up to the total number per shift and then add the points together. For example, if 4000 fasteners are fired in a shift, the total points will be the points for 3200 fasteners plus the points for 800 fasteners. Points can also be added together if using more than one tool in a shift.

The ready reckoner table can also be used to help you select a new nail or staple gun. Select a tool for which the **a+K** vibration value, when combined with the likely number of daily nails or staples, keeps the exposure in the dark green areas of the ready reckoner.

NAIL GUNS AND STAPLERS READY RECKONER										
Vibration magnitude (m/s ²)	15	38	75	150	300	600	1200	2400	4800	9600
	14	33	65	131	261	523	1045	2091	4181	8363
	13	28	56	113	225	451	901	1803	3605	7211
	12	24	48	96	192	384	768	1536	3072	6144
	11	20	40	81	161	323	645	1291	2581	5163
	10	17	33	67	133	267	533	1067	2133	4267
	9.5	15	30	60	120	241	481	963	1925	3851
	9	14	27	54	108	216	432	864	1728	3456
	8.5	12	24	48	96	193	385	771	1541	3083
	8	11	21	43	85	171	341	683	1365	2731
	7.5	9	19	38	75	150	300	600	1200	2400
	7	8	16	33	65	131	261	523	1045	2091
	6.5	7	14	28	56	113	225	451	901	1803
	6	6	12	24	48	96	192	384	768	1536
	5.5	5	10	20	40	81	161	323	645	1291
	5	4	8	17	33	67	133	267	533	1067
	4.5	3	7	14	27	54	108	216	432	864
	4	3	5	11	21	43	85	171	341	683
	3.5	2	4	8	16	33	65	131	261	523
3	2	3	6	12	24	48	96	192	384	
2.5	1	2	4	8	17	33	67	133	267	
2	1	1	3	5	11	21	43	85	171	
1.5	0	1	2	3	6	12	24	48	96	
1	0	0	1	1	3	5	11	21	43	
	100	200	400	800	1600	3200	6400	12800	25600	
Number of fasteners in shift										
Using the exposure points ready-reckoner										
1. Find the vibration magnitude (level) for the nail gun or stapler (or the nearest value) on the vertical scale on the left of the table.										
2. Find the number of fasteners fired in a typical shift (or the nearest value) on the horizontal scale across the bottom of the table.										
3. Find the value in the table that lines up with the magnitude and the number of fastenings.										
4. Compare the points value with the exposure action and limit values (100 and 400 points respectively).										
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.										
	Above ELV									
	Likely above ELV									
	Above EAV									
	Likely at or above EAV									
	Below EAV									

Complying with the Control of Vibration at Work Regulations 2005

If you identify that there is a risk from exposure to vibration you must take action to reduce the risk to as low as reasonably practicable. For all employees whose exposures are likely to be above the EAV, you should provide suitable health surveillance and information, instruction and training. This should include the signs and symptoms of HAVS and how to report them, the outcome of the risk assessment and the controls that are in place. It should also include instructions on how to use tools safely and minimise risks. For example, some nail guns commonly referred to as “bump action” tools are designed to work by contact actuation.

Employers should ensure that the correct training is given to operators so that the forces applied during bump action are kept to the minimum required for safe and effective operation.

You must prevent any exposures above the ELV. Further guidance can be found in HSE's guidance to the regulations which can be downloaded here:

<https://www.hse.gov.uk/pubns/priced/l140.pdf>