

VIBRATION

IO2 – EDUCATIONAL MATERIALS



Definition

Vibration is a mechanical phenomenon whereby oscillations occur about an equilibrium point.

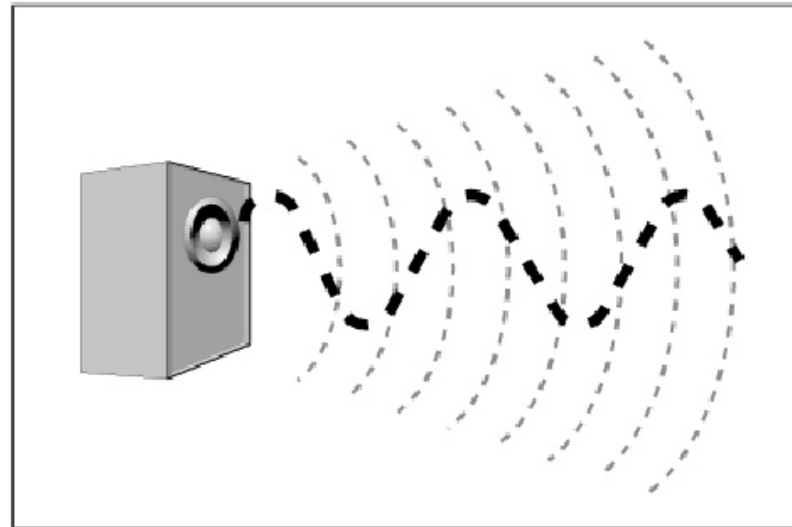
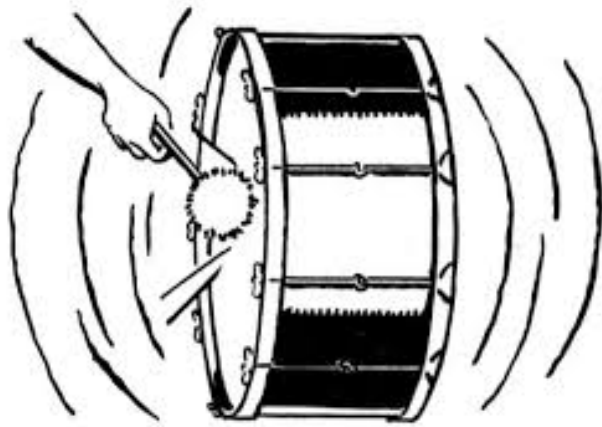


Figure 1 – Vibrate Sound. Source: idahoptv.org/sciencetrek/topics/sound/facts.cfm

Figure 2 – Sound Wave. Source: clipartcollections.com/science-sound-black-and-white-clipart-1/

Grinding

Grinding is a material removal and surface generation process used to shape and finish components made of metals and other materials

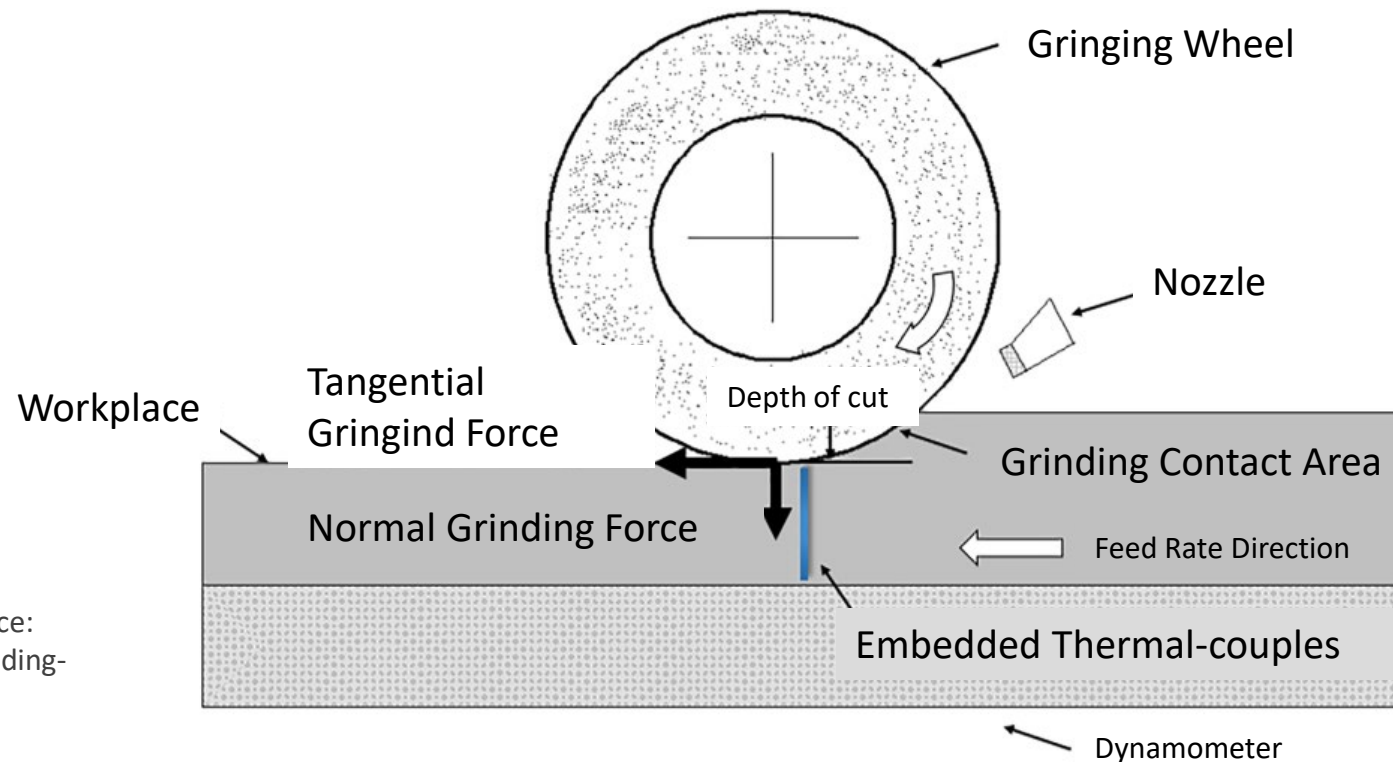


Figure 3 – Grinding Diagram. Source: wiringdiagramcenter.today/id-grinding-diagram.html

Types of Grinding

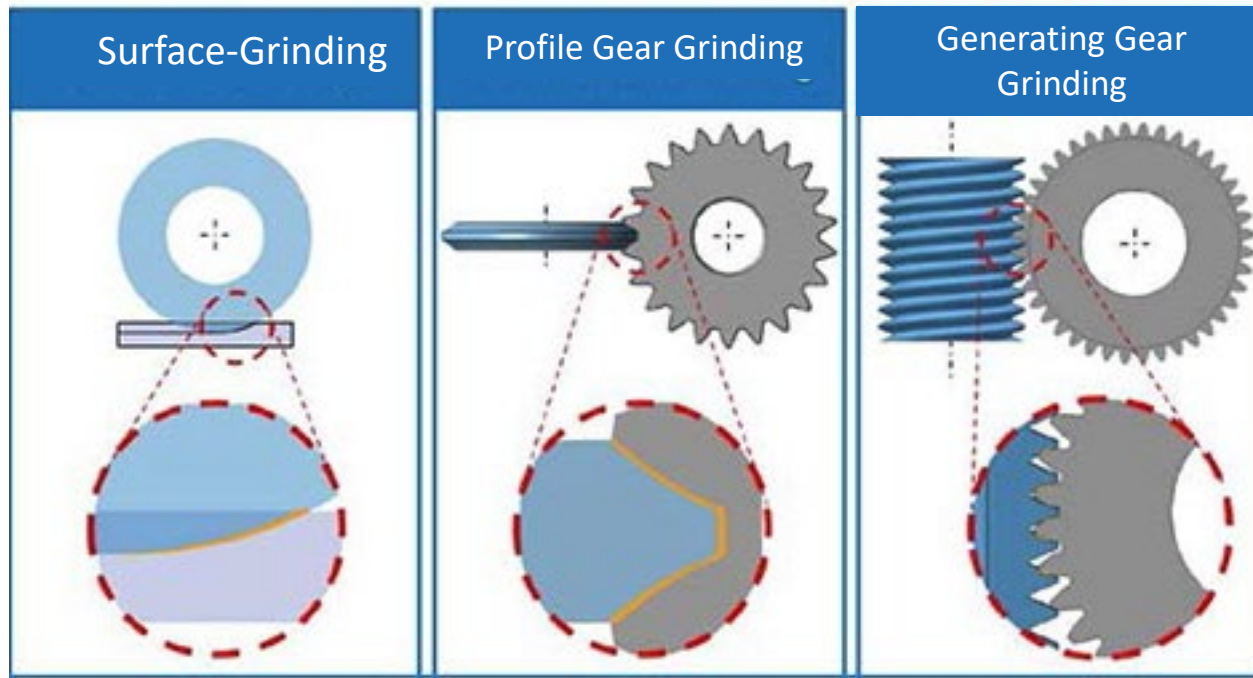


Figure 4 - Comparison of conventional grinding processes with gear grinding processes.
Source: https://www.researchgate.net/figure/Comparison-of-conventional-grinding-processes-with-gear-grinding-processes_fig1_296696398



Figure 5 – Abrasive Cutting. Source:
[www.wikiwand.com/en/Grinding_\(abrasive_cutting\)](http://www.wikiwand.com/en/Grinding_(abrasive_cutting))

Surface Grinding

Surface grinding is the most common of the grinding operations. It is a finishing process that uses a rotating abrasive wheel to smooth the flat surface of metallic or nonmetallic materials to give them a more refined look by removing the oxide layer and impurities on work piece surfaces.

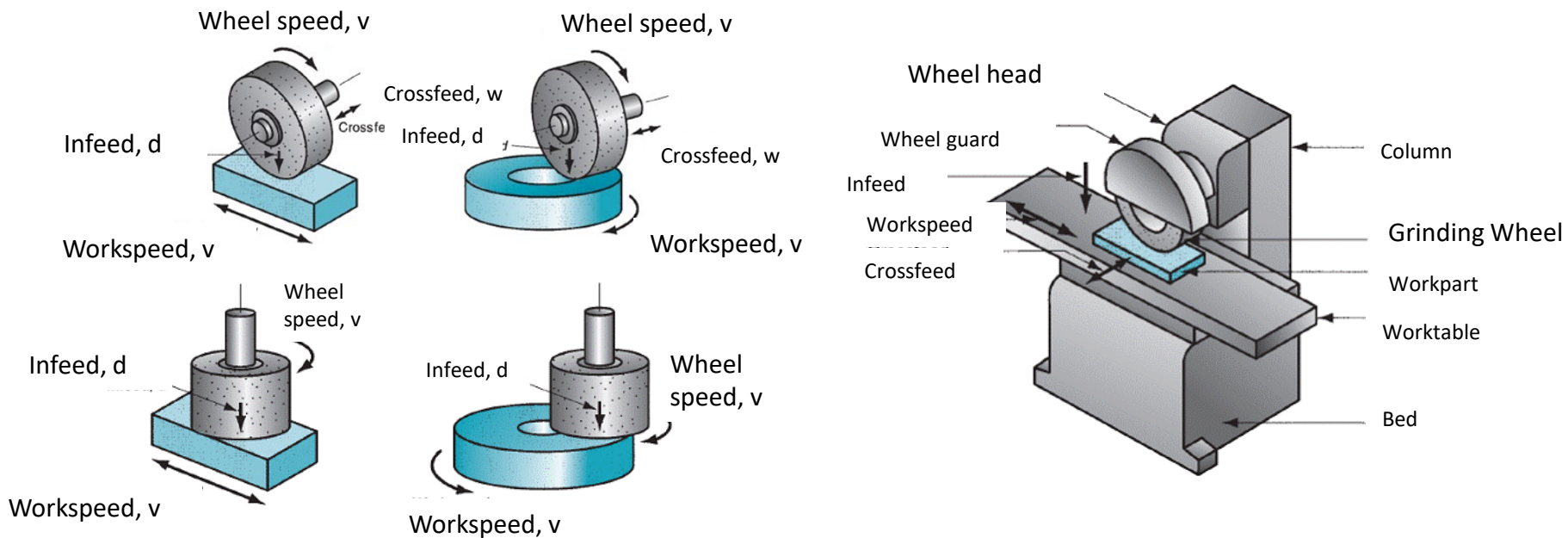


Figure 6 – surface grinding. Source: <https://www.forturetools.com/8-points-common-knowledge-of-grinding-wheel-safety/>

Profile Gear Grinding

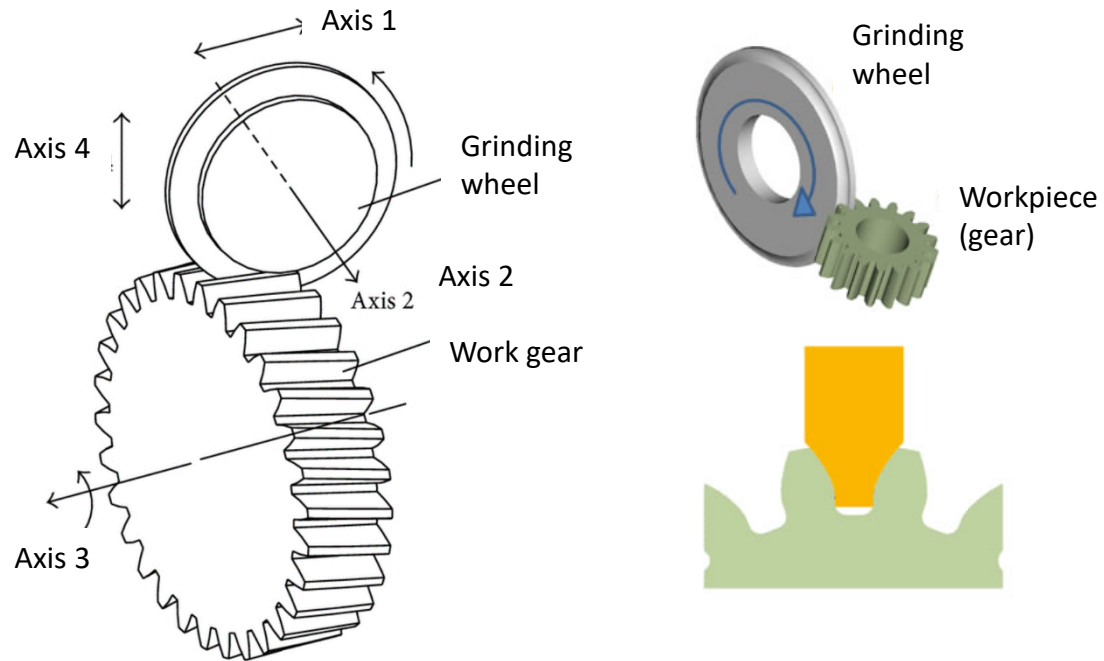


Figure 7 – Form grinding. Source:
https://www.researchgate.net/figure/Schematic-illustration-of-gear-form-grinding-by-a-grinding-wheel_fig8_276833763



Figure 8 –Source:
<https://mav.industrie.de/allgemein/innenverzahnungen-mit-dem-perfekten-schliff/>

Generation Gear Grinding

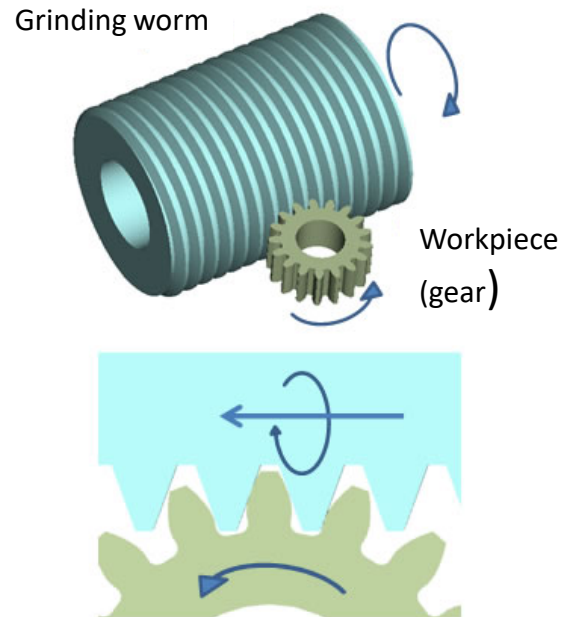


Figure 9 -continuous generating gear grinding. Source:
<https://www.yanmar.com/eu/Technology/YANMAR-Technical-Review/Introduction-to-Machine-Tools-Used-in-Gear-Processing/>

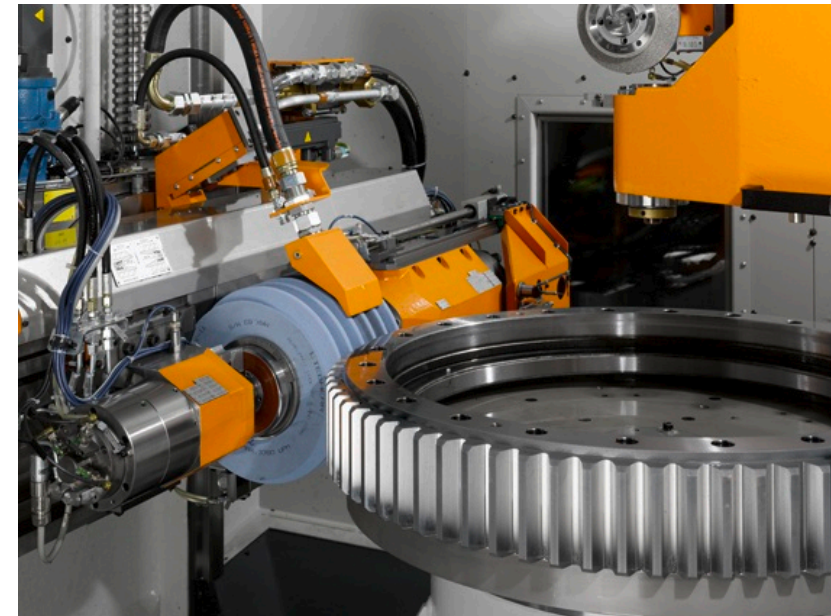


Figure 10 - gear grinding Source:
<https://www.mmsonline.com/suppliers/LIEBMAC/content/819720d1-5056-a300-1639-3a6fea7255b7>

Hand-arm Vibration – Control of Vibration at Work Regulations 2005

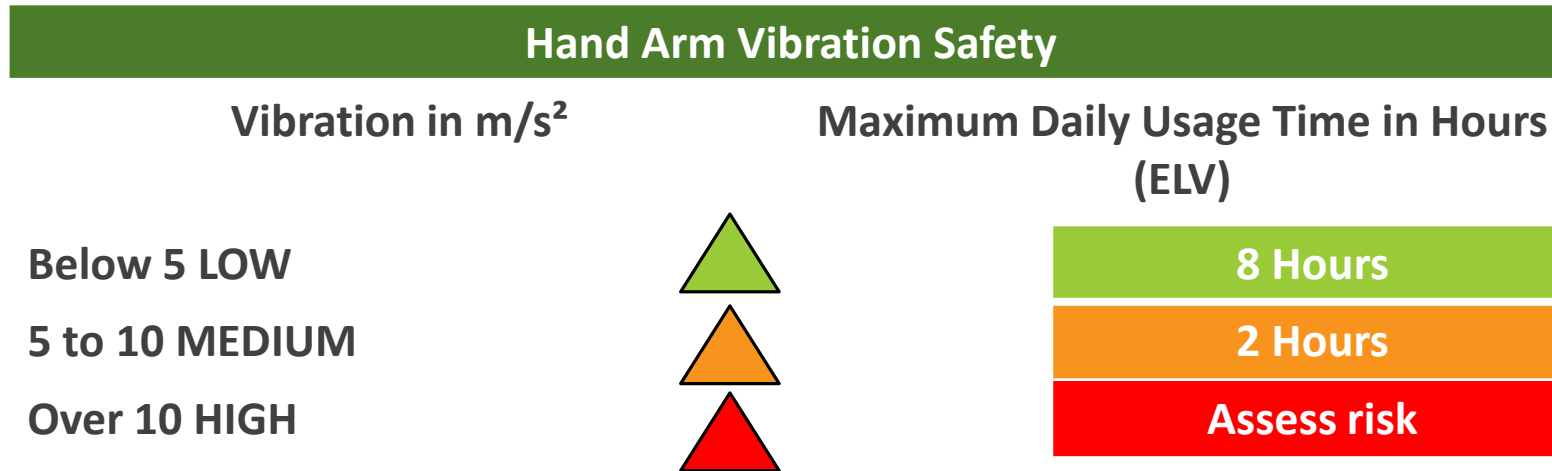


Figure 11 - Hand-arm vibration syndrome. Source: [https://www.gap-group.co.uk/assets/000/000/626/GAP_Tool_Box_Talk_-_Hand_Arm_Vibration_\(HAV\)_original.pdf?1424091413](https://www.gap-group.co.uk/assets/000/000/626/GAP_Tool_Box_Talk_-_Hand_Arm_Vibration_(HAV)_original.pdf?1424091413)

HAND ARM VIBRATION

WARNING

TOOL REF		
VIBRATION LEVEL	m/s^2	
TIME TO EAV	hrs	mins
TIME TO ELV	hrs	mins

Order Ref: -

Figure 12 - Warning. Source: <http://www.iosc.az/iosc/category.aspx?cid=1&csid=26>

HAND-ARM VIBRATION Control of Vibration at Work Regulations 2005

STATUTORY INSTRUMENTS	
2005 No. 1093	
HEALTH AND SAFETY	
The Control of Vibration at Work Regulations 2005	
<i>Made</i> - - - -	<i>4th April 2005</i>
<i>Laid before Parliament</i>	<i>7th April 2005</i>
<i>Coming into force</i> - -	<i>6th July 2005</i>
ARRANGEMENT OF REGULATIONS	
<ol style="list-style-type: none"> 1. Citation and commencement. 2. Interpretation. 3. Application and transitional provisions. 4. Exposure limit values and action values. 5. Assessment of the risk to health created by vibration at the workplace. 6. Elimination or control of exposure to vibration at the workplace. 7. Health surveillance. 8. Information, instruction and training. 9. Exemption certificates for emergency services. 10. Exemption certificates for air transport. 11. Exemptions relating to the Ministry of Defence. 12. Extension outside Great Britain. 13. Amendments. 	
<p>The Secretary of State, in the exercise of the powers conferred on him by sections 15(1), (2) and (5), and 82(3) of, and paragraphs 1(1)(a) and (c), 8(1), 9, 11, 13(2) and (3), 14, 15(1), 16 and 20 of Schedule 3 to, the Health and Safety at Work etc. Act 1974(a) ("the 1974 Act") and of all other powers enabling him in that behalf, for the purpose of giving effect without modifications to proposals submitted to him by the Health and Safety Commission under section 11(2)(d) of the 1974 Act after the carrying out by the said Commission of consultations in accordance with section 50(3) of that Act, hereby makes the following Regulations:</p>	
Citation and commencement	
<p>1. These Regulations may be cited as the Control of Vibration at Work Regulations 2005 and shall come into force on 6th July 2005.</p>	
<p>(a) 1974 c.37; sections 11(2), 15(1) and 50(3) were amended by the Employment Protection Act 1975 c.71, Schedule 15, paragraphs 4, 6 and 16(c) respectively.</p>	

Figure 13 -The Control of Vibration at Work Regulations 2005.
Source: www.hse.gov.uk/vibration/hav/regulations.htm

Hand-arm Vibration Effects

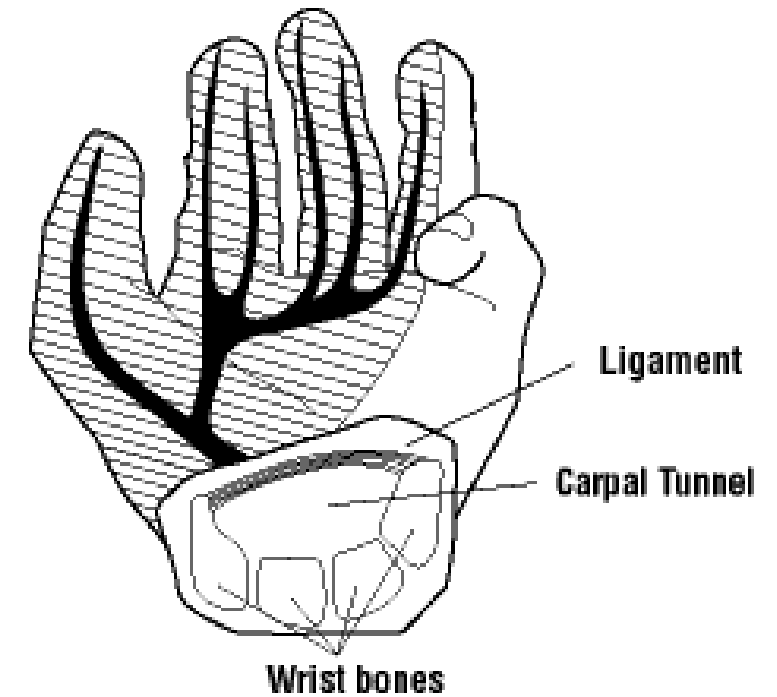
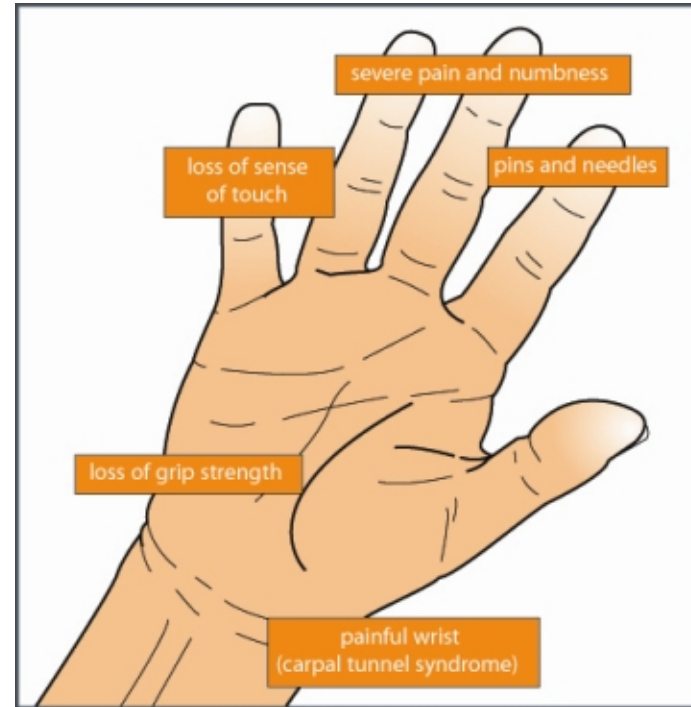


Figure 14, 15 & 16 - hand arm vibration syndrome. Source: <https://pdfs.semanticscholar.org/ee89/e7ba815b8bb476e807fe61b4707706cd8ea9.pdf>;
<https://www.ccohs.ca/oshanswers/diseases/carpal.html>; www.usptraining.co.uk/course_detail.php?id=1526

Hand-arm Vibration Effects



Figure 17 – Hand-arm vibration effects. Source: <https://spinecentre.com.au/repetitive-stress-injury-of-the-wrist-and-hands>; <https://www.ishn.com/gdpr-policy?url=https%3A%2F%2Fwww.ishn.com%2Farticles%2F93261-nerve-damage-to-my-hands--how-can-i-tell->

Vibration & Welding World

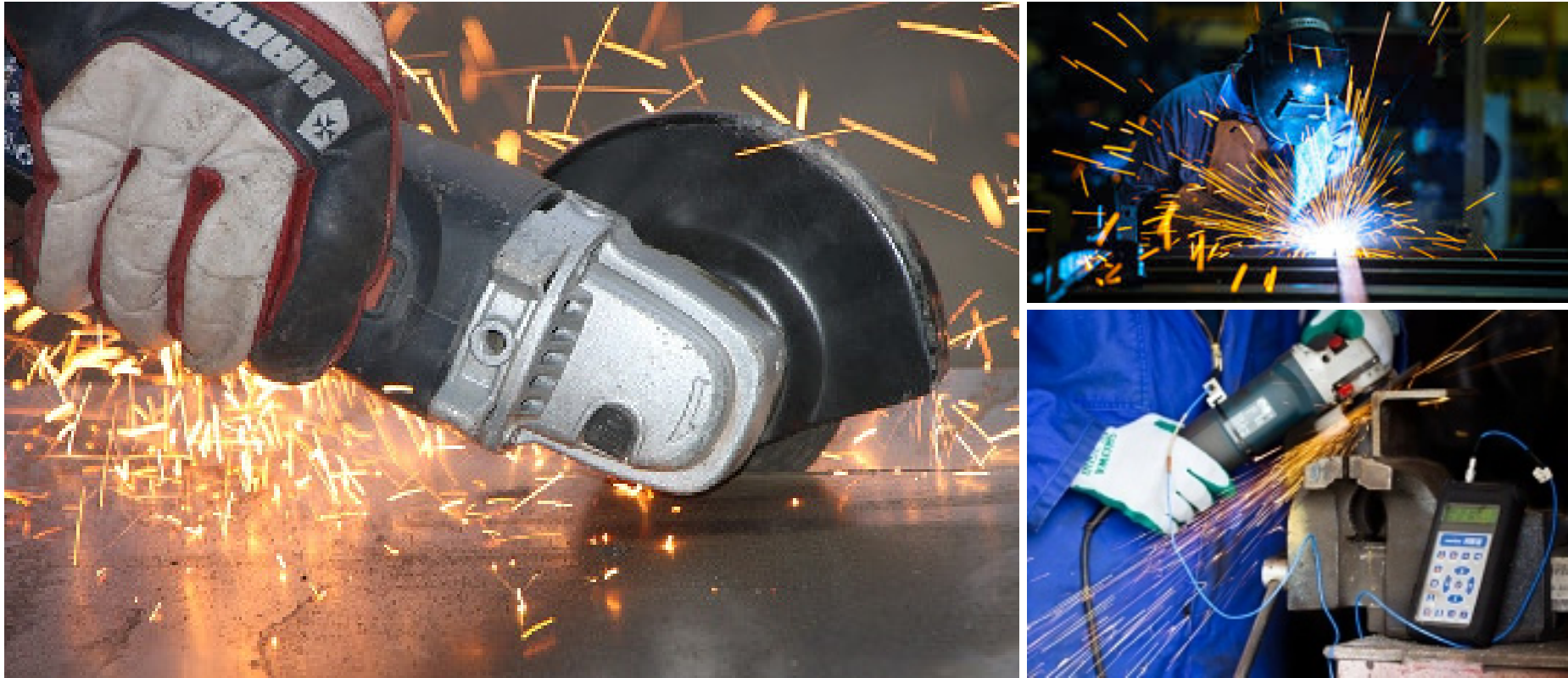


Figure 18 – Grinding machine. Source: <https://pixabay.com/pt/%C3%A2ngulo-corte-moedor-ferro-metal-87437/>; <http://casefe.com.au/>

How to measure the HAV

There are two primary methods that you can use to obtain the vibration magnitude values for power tools:

1. Use declared vibration values provided by tool manufacturers as an estimate.
2. Measure in-use vibration magnitude with a vibration meter.



Figure 19 -HAV tags. Source: www.handytag.co.uk/vibration



Figure 20 – HAV risk mobile app.

Source:
<http://www.torrenttrackside.co.uk/product/reactec-havs-analytics-platform/>

How to measure the HAV



The HAVi Hand Arm Vibration Monitor tracks the length of time that a worker is exposed to power tool vibration. Given the vibration magnitude for the tool, it then calculates the total exposure and displays the HSE points.



This instrument makes all the measurements required for a vibration risk assessment in line with the regulations, and it is designed specifically for hand-arm vibration

Figure 21 - Hand Arm Vibration Monitor. Source: <https://www.noisemeters.com/product/havs/havi/>



HAND-ARM VIBRATION EXPOSURE CALCULATOR

Version 4.3 January 2014

Tool or process name	Vibration magnitude m/s ² r.m.s.	Exposure points per hour	Time to reach EAV 2.5 m/s ² A (8)		Time to reach ELV 5 m/s ² A (8)		Exposure duration		Partial exposure m/s ² A (8)	Partial exposure points
			hours	minutes	hours	minutes	hours	minutes		
Tool or process 1										
Tool or process 2										
Tool or process 3										
Tool or process 4										
Tool or process 5										
Tool or process 6										

☒ Lock Tool or process names

Instructions for use:

Enter vibration magnitudes and exposure durations in the white areas

To calculate, press <Enter>, or move the cursor to a different cell

The results are displayed in the yellow areas

To clear all cells, click on the '**Reset**' button

Tick the '**Lock tool or process name**' check box to prevent '**Reset**' clearing these cells

For more information, click the '**Help**' button

Daily exposure m/s ² A (8)	Total exposure points

Figure 22 – Hand-arm vibration exposure calculator. Source: <http://www.hse.gov.uk/vibration/hav/vibrationcalc.htm>

PPI



Figure 23- Grinding operations. Source: www.safeguardtraining.com

ISO 10819:2013

Mechanical vibration and shock - Hand-arm vibration - Measurement and evaluation of the vibration transmissibility of gloves at the palm of the hand



This International Standard specifies a method for the laboratory measurement, data analysis, and reporting of the vibration transmissibility of a glove with a vibration-reducing material that covers the palm, fingers, and thumb of the hand. This International Standard specifies vibration transmissibility in terms of vibration transmitted from a handle through a glove to the palm of the hand in one-third-octave frequency bands with centre frequencies of 25 Hz to 1 250 Hz.



Figure 24 – International standards (ISO 10819) & Figure 25 – EN 10819

ISO 10819:2013

- EN 169: Personal eye-protection. Filters for welding and related techniques. Transmittance requirements and recommended use
- EN 170: Personal eye-protection. Ultraviolet filters. Transmittance requirements and recommended use
- EN 171: Personal eye-protection. Infrared filters. Transmittance requirements and recommended use
- EN 175: Personal protection. Equipment for eye and face protection during welding and allied processes
- EN 379: Personal eye-protection. Automatic welding filters
- EN 1598: Health and safety in welding and allied processes. Transparent welding curtains, strips and screens for arc welding processes.