IConstruction Hazard and Risk Control

Lecture Title: Physical and Psychological health hazards and risk control

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Undergraduate Diploma in Occupational Health and Safety

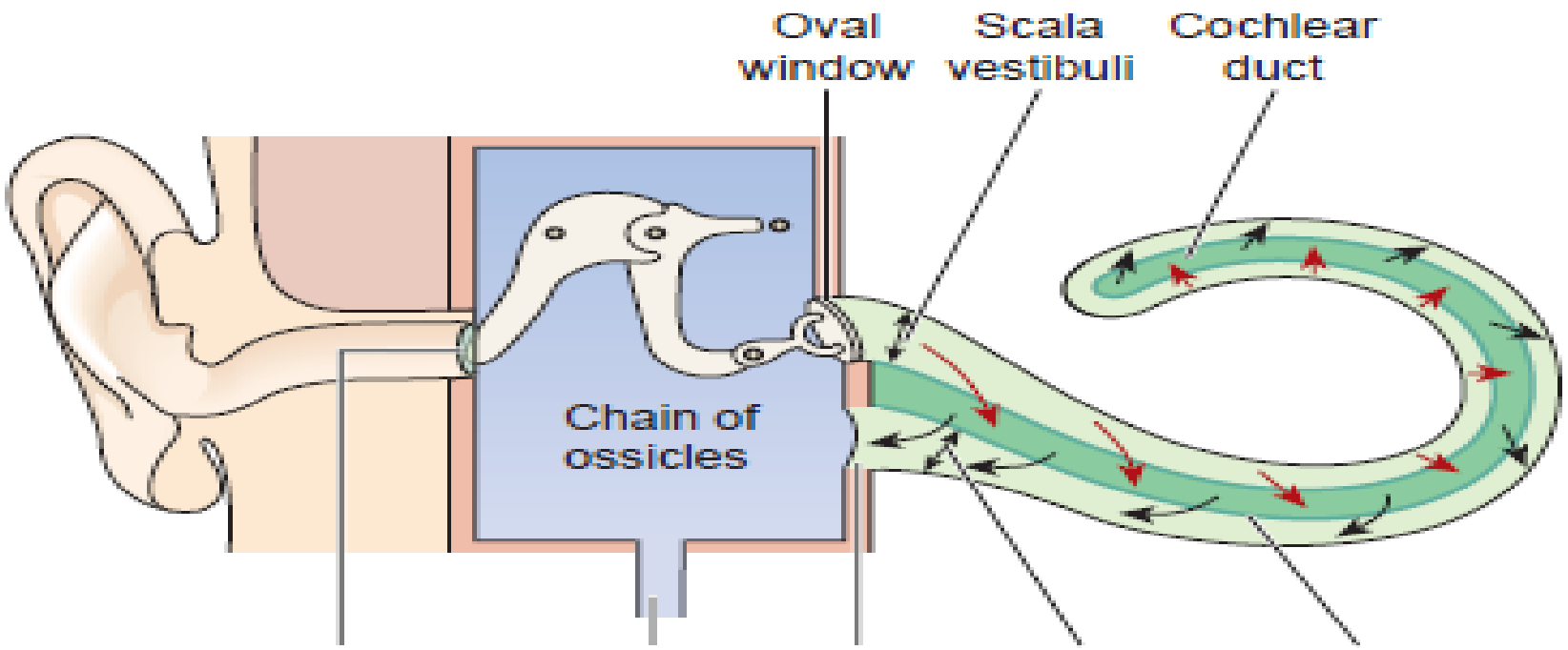
This lecture covers the following learning objectives:

- Outline the health effects associated with exposure to noise and appropriate control measures
- Outline the health effects associated with exposure to vibration and appropriate control measures
- Outline the health effects associated with ionising and non-ionising radiation and outline appropriate control measures
- Outline the causes and effects of work-related stress and appropriate control measures

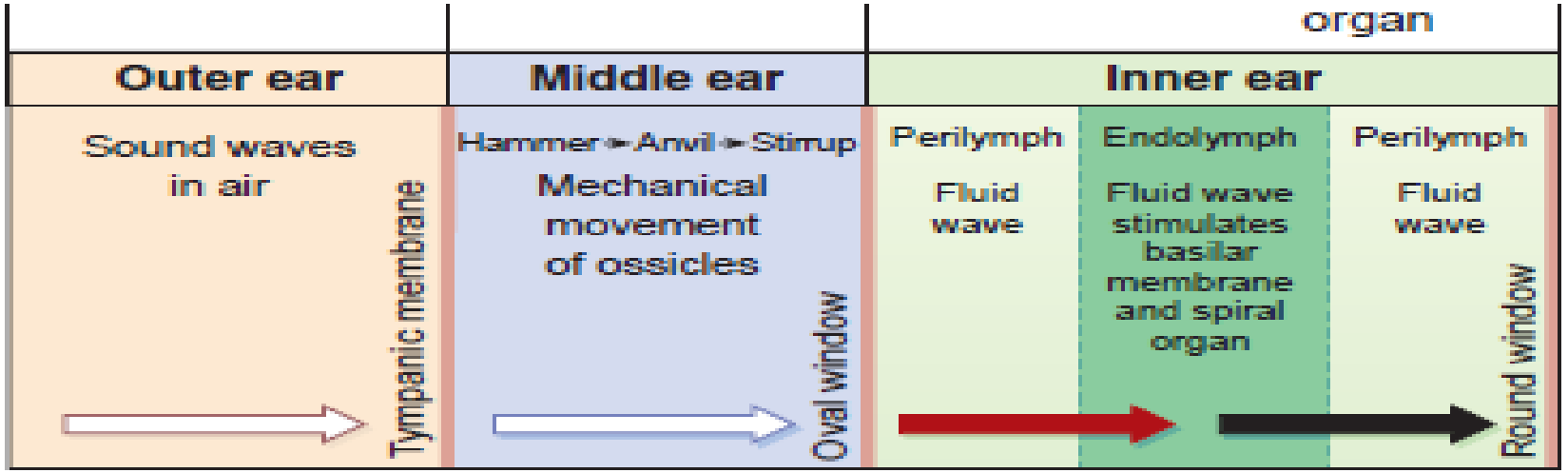
Noise- Health affects of Noise

- Human ear:

- Ear drum
- Cochlea
- Hair cells – damage irreversible
- Auditory nerve


Oval window
Scala vestibuli
Cochlear duct
Chain of ossicles
Tympanic membrane
Auditory tube
Round window
Scala tympani
Basilar membrane and spiral organ

(a)


Outer ear
Middle ear
Inner ear
Sound waves in air
Tympanic membrane
Hammer → Anvil → Stirrup
Mechanical movement of ossicles
Oval window
Perilymph
Fluid wave
Endolymph
Fluid wave stimulates basilar membrane and spiral organ
Perilymph
Fluid wave
Round window

(b)

Noise- Health affects of Noise

Acute effects:

1. **Temporary threshold shift**- caused by short excessive noise exposures and affects the cochlea by reducing the flow of nerve impulses to the brain. The result is a slight deafness, which is reversible when the noise is removed;
2. **Tinnitus** a ringing in the ears caused by an intense and sustained high noise level. It is caused by the over-stimulation of the hair cells. The ringing sensation continues for up to 24 hours after the noise has ceased;
3. **Acute acoustic trauma** caused by a very loud noise such as an explosion. It affects either the eardrum or the bones in the middle ear and is usually reversible. Severe explosive sounds can permanently damage the eardrum.

Noise- Health affects of Noise

Chronic effects:

1. **Noise**-induced hearing loss results from permanent damage to the cochlear hair cells. It affects the ability to hear speech clearly but the ability to hear is not lost completely;
2. **Permanent** threshold shift this results from prolonged exposure to loud noise and is irreversible due to the permanent reduction in nerve impulses to the brain. This shift is most marked at the 4000 Hz frequency, which can lead to difficulty in hearing certain consonants and some female voices;
3. **Tinnitus** is the same as the acute form but becomes permanent. It is a very unpleasant condition, which can develop without warning.

Noise assessments

- Objective is to identify whether action levels have been reached.

Noise measurement

- Sound pressure level (SPL) – dB(A)
- Peak sound pressure
- Continuous equivalent noise level (LEq) – normally measured over an 8-hour period
- Daily personal exposure level (LEP,d)

Some typical sound pressure levels (dB(A)) for construction processes

Activity or environment	SPL [dB(A)]
Nail gun	130–140
Piling work	1001
Blasting	1001
Shovelling hardcore	94
Sandblasting	85–90
Carpenter	86–96
Excavator driver	85
Dumper truck driver	85
Asphalt paving	85
Bricklayer	81–85

Requirements of Noise at Work Regulation

- assess noise levels and keep records;
- reduce the risks from noise exposure by engineering controls – only use hearing protection as a last resort;
- provide employees with information and training; and
- if a manufacturer of equipment, provide information on noise levels of the equipment

Noise action levels:

1. The lower exposure action levels are:

(a) a daily or weekly personal noise exposure of **80 dB(A)**;

(b) a peak sound pressure of **135 dB(C)**.

2. The upper exposure action levels are:

(a) a daily or weekly personal noise exposure of **85 dB(A)**;

(b) a peak sound pressure of **137 dB(C)**.

3. The exposure limit values are:

(a) a daily or weekly personal noise exposure of **87 dB(A)**;

(b) a peak sound pressure of **140 dB(C)**.

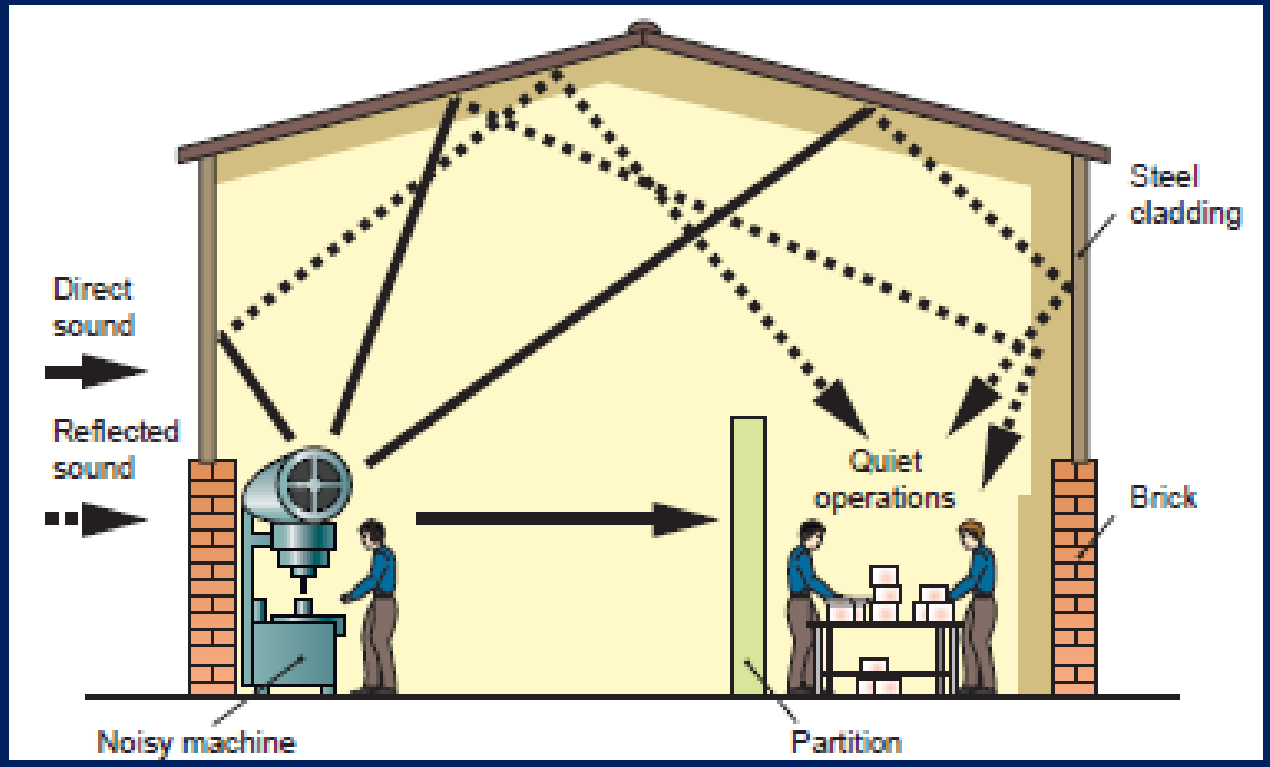
Noise action levels: The need for a noise risk assessment.

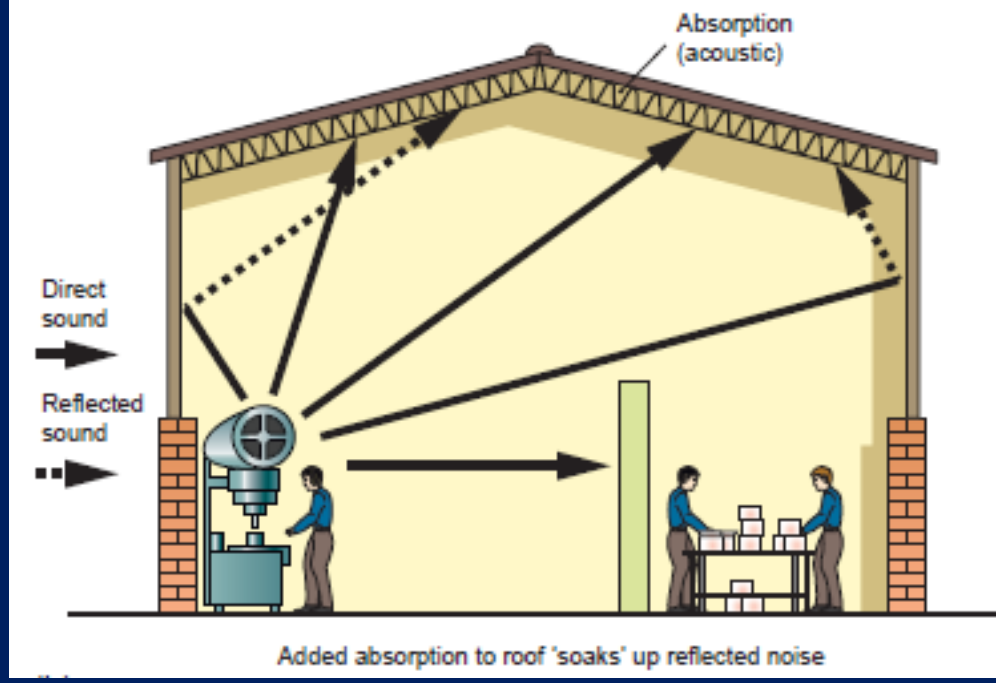
Observation at the workplace	Likely noise level [dB(A)]	A noise risk assessment must be made if this noise level persists for
The noise is noticeable but does not interfere with normal conversation – equivalent to a domestic vacuum cleaner	80	6 hours
People have to shout to be heard if they are more than 2 m apart	85	2 hours
People have to shout to be heard if they are more than 1 m apart	90	45 minutes

Noise control techniques include

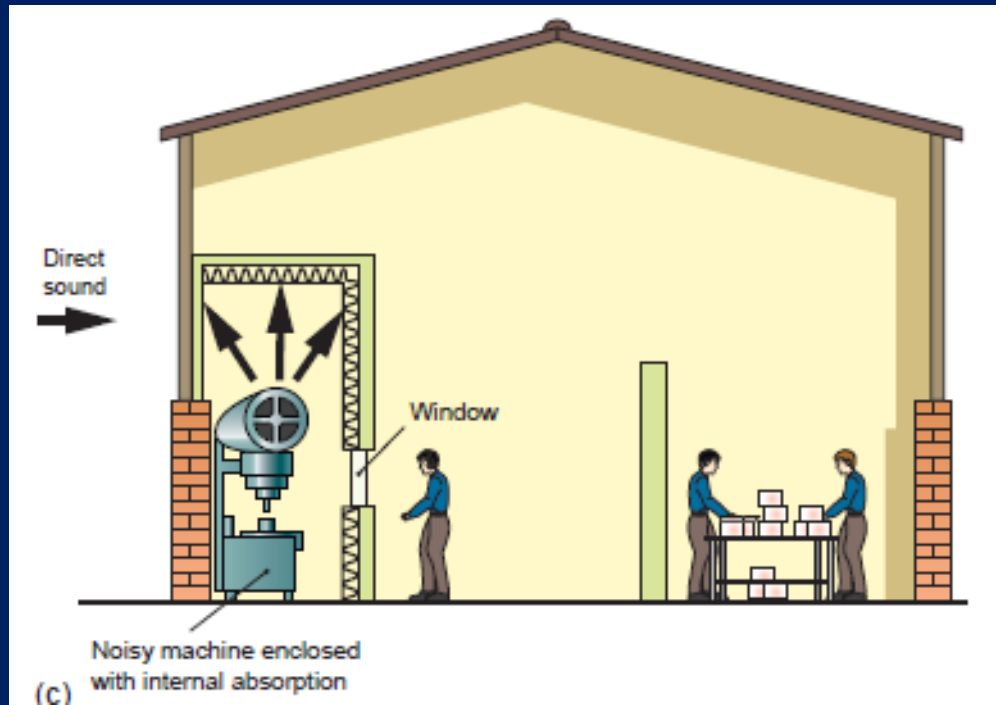
- Reduction of noise at source
- Change equipment or process
- Change speed
- Improve maintenance
- Relocate equipment
- Enclose equipment
- Screens or absorption walls
- Damping
- Lagging
- Silencers
- Isolation of workers
- Suitable warning signs.

Reduction of noise at source





Added absorption to roof 'soaks' up reflected noise



(c)

Attenuation of noise levels

Orientation or re-location of the equipment – turn the noisy equipment away from the workforce or locate it away in separate and isolated areas.

Enclosure – surrounding the equipment with a good sound-insulating material can reduce sound levels by up to 30 dB(A). Care will need to be taken to ensure that the machine does not become overheated.

Screens or absorption walls – can be used effectively in areas where the sound is reflected from walls. The walls of the rooms housing the noisy equipment are lined with sound absorbent material, such as foam or mineral wool, or sound absorbent (acoustic) screens are placed around the equipment.

Attenuation of noise levels

Damping – the use of insulating floor mountings to remove or reduce the transmission of noise and vibrations through the structure of the building such as girders, wall panels and flooring.

Lagging – the insulation of pipes and other fluid containers to reduce sound transmission (and, incidentally, heat loss).

Silencers – normally fitted to engines which are exhausting gases to atmosphere. Silencers consist of absorbent material or baffles.

Isolation of the workers – the provision of soundproofed workrooms or enclosures isolated from noisy equipment (a power station control room is an example of worker isolation).

Personal ear protection:

- Ear plugs are made of sound absorbent material and fit into the ear. They can be reusable or disposable, and are able to fit most people and can easily be used with safety glasses and other personal protective equipment. Their effectiveness depends on the quality of the fit in the ear which, in turn, depends on the level of training given to the wearer.

- Ear defenders (earmuffs):offer a far better reduction of all sound frequencies. They are generally more acceptable to workers because they are more comfortable to wear and they are easy to monitor as they are clearly visible. They also reduce the sound intensity transmitted through the bone structure surrounding the ear.

Hearing Conservation and Safety Training Video

- https://youtu.be/fG6CL3-CFRU?t=853

Personal ear protection; Factors to be considered:

- Suitability (frequencies)
- Acceptability and comfort
- Durability
- Instruction in use
- Hygiene considerations
- Beards, hair and spectacles may reduce effectiveness of protection
- Maintenance and storage
- Cost

Vibration

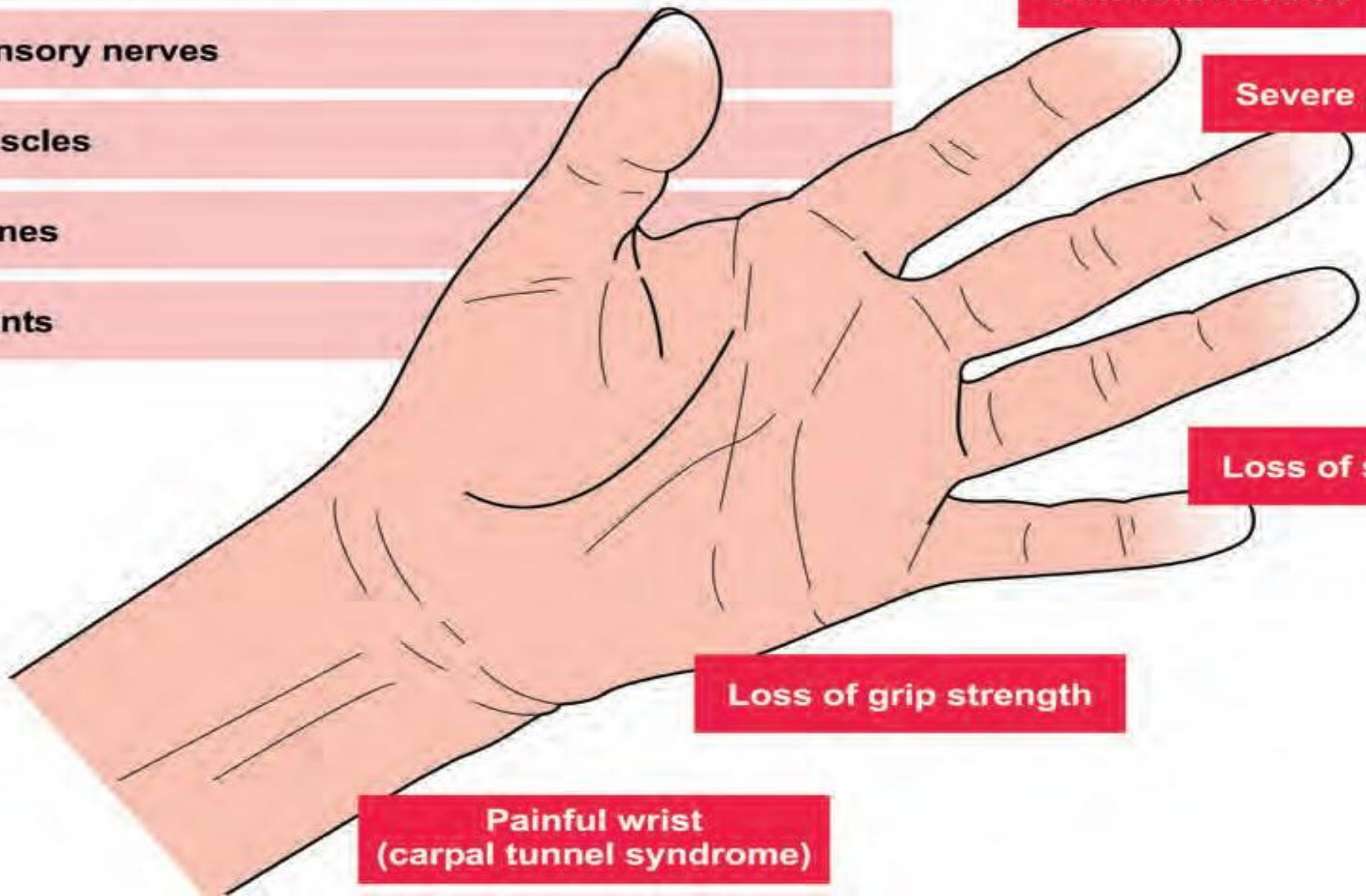
Ill-health due to vibration

Ill-health due to hand–arm vibration

- Hand–arm vibration syndrome (HAVS)
- Vibration White Finger (VWF)
- Carpal tunnel syndrome

Regular exposure to HAV can cause a range of permanent injuries to hands and arms, collectively known as hand–arm vibration syndrome (HAVS). The injuries can include damage to the:

- Blood circulatory system (e.g. vibration white finger)
- Sensory nerves
- Muscles
- Bones
- Joints



Pins and needles

Severe pain and numbness

Loss of sense of touch

Loss of grip strength

Painful wrist (carpal tunnel syndrome)

Examples of vibration exposure values measured on work equipment

Equipment	Condition	Vibration reading (m/s²)
Road breakers	Typical	12
	Modern design and trained operator	5
	Worst tools and operating conditions	20
Demolition hammers	Modern tools	8
	Typical	15
	Worst tools	25
Hammer drills	Typical	9
	Best tools and operating conditions	6
	Worst tools and operating conditions	25
Large-angle grinders	Modern vibration-reduced designs	4
	Other types	8
Small-angle grinders	Typical	2–6
Chainsaws	Typical	6
Brush cutter or strimmer	Typical	4
	Best	2
Sanders (orbital)	Typical	7–10

Ill-health due to whole-body vibration

- Severe back pain
- Reduced visual and manual control
- Increased heart rate and blood pressure
- Spinal damage

Control of Vibration at Work Regulations

The requirements of the Regulations are to:

- assess the vibration risk to employees;
- decide if they are likely to be exposed above the daily exposure action value (EAV) or the daily exposure limit level (ELV) and if they are in either case, take appropriate action;
- provide information and training on health risks and controls to employees at risk;
- consult safety representatives or employee representatives about the risks and the plans to address these risks;
- keep a record of the risk assessment and control actions; and
- review and update the risk assessment regularly

Exposure limit and action values

For hand–arm vibration (HAV):

- the daily exposure limit value normalised to an 8-hour reference period is 5 m/s2
- the daily exposure action value normalised to an 8-hour reference period is 2.5 m/s2.

For whole-body vibration (WBV):

- the daily exposure limit value normalised to an 8-hour reference period is 1.15 m/s2
- the daily exposure action value normalised to an 8-hour reference period is 0.5 m/s2

Preventative and precautionary measures

The common measures used to control ergonomic ill-health effects are:

- identification of repetitive actions;
- the elimination of vibration by performing the job in a different way;
- undertake a risk assessment;
- ensure that the correct equipment (properly adjusted) is always used;
- introduce job rotation or frequent breaks so that workers have a reduced time exposure to the hazard;
- during the design of the job ensure that poor posture is avoided

Preventative and precautionary measures

- issue employees with gloves and warm clothing;
- examine ill-health reports and absence records;
- introduce a programme of health surveillance;
- ensure that workers are given adequate information on the hazards and develop a suitable training programme;
- introduce a reporting system for employees to use so that concerns and any symptoms can be recorded and investigated;

Preventative and precautionary measures

- ensure that drill bits and other tools are kept sharp;
- ensure that a programme of preventative maintenance is introduced and include the regular inspection of items such as vibration isolation mountings; and
- keep up to date with advice from equipment manufacturers, trade associations and health and safety sources.

Additional information on whole-body vibration

The reasons for back pain in drivers include:

- poor posture while driving;
- incorrect adjustment of the driver's seat;
- sitting for long periods without being able to change position;
- difficulty in reaching all relevant controls due to poor design of the controls layout;
- frequent manual handling of loads;
- frequent climbing up and down from a high cab;
- excessive exposure to whole-body vibration

Actions for controlling the risks from WBV need to ensure that:

- the driver's seat is correctly adjusted so that all controls can be reached easily and that the driver weight setting on the suspension seat, if available, is correctly adjusted. The seat should have a back rest with lumbar support;
- anti-fatigue mats are used if the operator has to stand for long periods;
- the speed of the vehicle is such that excessive jolting is avoided; speeding is one of the main causes of excessive WBV;
- all vehicle controls and attached equipment are operated smoothly

Actions for controlling the risks from WBV need to ensure that:

- only established site roadways are used;
- only suitable vehicles and equipment are selected to undertake the work and cope with the ground conditions;
- the site roadway system is regularly maintained;
- all vehicles are regularly maintained, with particular attention being paid to tyre condition and pressures, vehicle suspension systems and the driver's seat

Actions for controlling the risks from WBV need to ensure that:

- work schedules are regularly reviewed so that long periods of exposure on a given day are avoided and drivers have regular breaks;
- prolonged exposure to WBV is avoided for at-risk groups (older people, young people, people with a history of back problems and pregnant women); and
- employees are aware of the health risks from WBV, the results of the risk assessment and the ill-health reporting system. They should also be trained to drive in such a way that excessive vibration is reduced

General points on vibration

- A person who is warm and dry is less likely to suffer from HAV.
- HAV can cause damage to blood vessels and nerves in hands and fingers.
- The effects of HAV can be reduced if the work is done in short intervals.
- Anti-vibration gloves may not always protect against vibration

Vibration at Work - Hazards and Controls

- https://youtu.be/n57IfVXrgIU

Radiation- Radiation hazard

Ionising radiation

Ionising radiation is produced by alpha and beta particles and gamma rays.

- Harmful effects:

- Somatic – cell damage to the individual
- Genetic – cell damage to any future children of the individual
- Acute – nausea, vomiting, skin burns and blistering, collapse and death
- Chronic – anaemia; leukaemia and other types of cancer.

Ionising radiation

Sources

- Radon gas
- X-ray equipment
- Smoke detectors

Non-ionising radiation

- Ultraviolet radiation – sun, arc welding
- Lasers – eye and skin burns, electricity etc.
- Infrared radiation – fires, furnaces, etc.
- Microwaves – cookers/ovens, mobile telephones.

Non-ionising radiation can harm the eyes and skin.

Non-ionising radiation

Hierarchy of controls for outdoor working:

- relocate some jobs inside a building or to a shady location;
- undertake some outdoor work earlier or later in the day;
- provide personal protection such as:
- wearing long sleeve shirts or loose clothing with a close weave;
- wearing hats with a wide brim;
- using a high factor sunscreen of at least SPF15 on any exposed skin;
- provide suitable education and training for outdoor workers;
- provide suitable information and supervision to instigate safe systems of work that protect workers from the sun.

Other Protective measures

Non-ionising radiation

- Eye protection
- Skin protection (gloves and/or creams)
- Fixed shields and non-reflective surfaces (screen must be in place before welding operations begin to protect others in the area from getting arc eye)
- Interlocking guards on microwaves

Ionising radiation

Radiation protection strategies:

- Risk assessment
- Shielding
- Time (reduced time exposure)
- Distance
- Training
- Personal protective equipment
- No food or drink consumption near exposed areas
- Signs and information
- Medical surveillance
- Maintenance and inspection controls
- Emergency procedures
- Radiation protection supervisor – appointed to advise on compliance with Regulations
- Radiation protection adviser – appointed to advise the radiation protection supervisor

Stress

Work-related stress is the reaction people have to excessive pressure or other types of demand placed on them.

It is the reaction of the body to excessive mental pressure that may lead to ill-health.

Symptoms of stress

There are four groups of stress symptoms:

- physical – chest pains and frequent colds;
- behavioural – smoke and drink more;
- emotional – irritable and depressed; and
- cognitive – unable to concentrate and very anxious

Stress- Causes

- The job itself – unrealistic targets, boring, repetitive, insufficient training
- Individual responsibility – ill-defined roles, too much responsibility, too little control to influence outcome
- Working conditions – lack of privacy or security, unsafe practices, threat of violence, excessive noise
- Management attitudes – negative health and safety culture, poor communication, lack of support in a crisis
- Relationships with colleagues – bullying, harassment

Stress- Prevention:

- Take a positive attitude to stress
- Take employee concerns seriously
- Effective communication and consultation
- Develop a policy on stress
- Relevant training
- Employee appraisal system
- Discourage excessive hours at work
- Encourage lifestyle changes
- Monitor incidents of bullying, etc.
- Avoid blame culture
- Set up a confidential counselling advice service.

21 ACADEMY

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