

Managing Physical Hazards

Lecture Title: Introduction to Physical Hazards & Regulatory Frameworks

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**Undergraduate Diploma in
Occupational Health and Safety**



Welcome and Objectives

After this lecture, students will be able to:

1. Explain what physical hazards are and how they differ fundamentally from other hazard types.
2. Identify the major classes of physical hazards encountered in the workplace.
3. Understand how physical hazards interact with the human body (exposure pathways).
4. Describe the specific Maltese and EU legal frameworks governing physical agents.
5. Understand the operational role of OHSA Malta in regulating physical hazards.



Part A — Welcome, Module Roadmap & Transition from Risk Management

Lecture 1 — Introduction to Physical Hazards & Regulatory Frameworks

Lecture 2 — Measurement & Monitoring Techniques for Physical Hazards

Lecture 3 — Noise & Vibration Hazards: Exposure, Measurement & Control

Lecture 4 — Physical Hazard Control Strategies: Engineering, Administrative & PPE

Lecture 5 — Thermal Hazards: Heat Stress, Cold Stress, and Thermal Comfort

Lecture 6 — Radiation Hazards: Ionising and Non-Ionising

Lecture 7 — Lighting, Visibility, and Workplace Ergonomics

Lecture 8 — Machinery, Mechanical Hazards & Machine Safeguarding

Lecture 9 — Workplace Environment Hazards: Slips, Trips, Falls, and Confined Spaces

Lecture 10 — Integrated Physical Hazard Management & Continuous Improvement

This module focuses on physical agents and their technical, physiological, and legal considerations



Part B — What Are Physical Hazards?

1. A physical hazard is any condition, agent, or factor in the workplace that can cause harm, injury, or damage through physical means or energy transfer
2. Physical hazards arise from equipment, environmental conditions, or the physical arrangement of the workplace, and can injure workers with or without direct contact.
3. The International Labour Organization (ILO) defines physical hazards as risks caused by physical agents or conditions such as noise, vibration, radiation, electricity, heat, or cold that have the potential to cause injury or physical harm. [ilo.org]



Part B — What Are Physical Hazards?

1. Definition & distinguishing features

What makes physical hazards unique compared to:

1. chemical (reactivity)
2. biological (pathogenicity)
3. ergonomic (biomechanics)
4. psychosocial (behavioural)

Focus on the energy transfer principle

Focus: Intensity and duration of energy exposure



EXAMPLES OF PHYSICAL RISKS



**MANUAL
HANDLING**



**REPETITIVE
MOVEMENTS**



VIBRATION



RADIATION



NOISE



**TEMPERATURE
EXTREMES**



**SLIPS,
TRIPS, FALLS**



ELECTRICITY



ELECTRICITY



**MACHINERY
HAZARDS**



**PRESSURE
SYSTEMS**

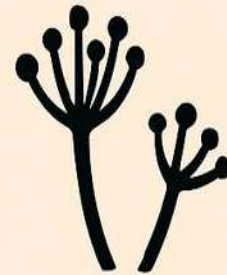
EXAMPLES OF BIOLOGICAL RISKS



BACTERIA



VIRUSES



FUNGI



PARASITES



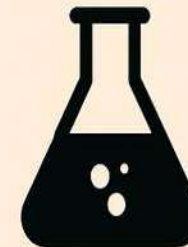
**BLOOD AND
BODY FLUIDS**



**ANIMAL
CONTACT**



**INSECT
BITES**

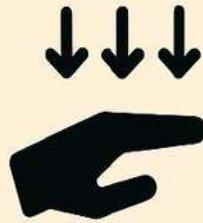


**BIOHAZARDOUS
SUBSTANCES**

EXAMPLES OF ERGONOMICS RISKS



**AWKWARD
POSTURES**



**REPETITIVE
MOTIONS**



**FORCEFUL
EXERTIONS**



**STATIC
POSITIONS**



VIBRATION



**CONTACT
STRESS**



**HIGHLY
REPETITIVE
WORK**



**POOR
WORKSTATION
LAYOUT**

EXAMPLES OF PSYCHOSOCIAL RISKS



STRESS



BURNOUT



**HIGH JOB
DEMANDS**



**LACK OF
CONTROL**



HARASSMENT



VIOLENCE



**POOR
SUPPORT**



**JOB
INSECURITY**

EXAMPLES OF CHEMICAL RISKS



IRRITANTS



CORROSIVES



FLAMMABLES



CARCINOGENS



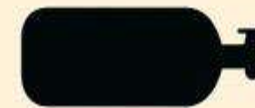
SENSITIZERS



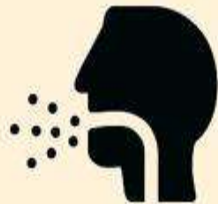
TOXIC
SUBSTANCES



MUTAGENS



COMPRESSED
GASES



Hazard Categories in OHS

2. Definition & distinguishing features

Physical Risks

Physical risks include hazards like noise and heat that can harm workers' health and safety.

Chemical Risks

Chemical risks involve exposure to toxins and fumes that can cause serious health issues.

Biological Risks

Biological risks cover viruses, bacteria, and other pathogens that threaten employee health.

Ergonomic Risks

Ergonomic risks arise from repetitive strain and poor posture causing musculoskeletal problems.

Psychosocial Risks

Psychosocial risks include stress and bullying, impacting mental wellbeing and productivity.

Categories of Physical Hazards

1. Noise
2. Vibration
3. Thermal (heat/cold)
4. Radiation (ionising & non ionising)
5. Mechanical hazards
6. Lighting & visibility

Part B — What Are Physical Hazards?

3. How physical hazards affect the human body?

Physical Hazards harm the body through energy transfer, leading to specific physiological effects.

Noise → Hearing Pathway

Sound pressure waves enter the ear

Vibrate the tympanic membrane & cochlea

Damage to hair cells

Outcome: hearing loss, tinnitus



Part B — What Are Physical Hazards?

3. How physical hazards affect the human body?

Physical Hazards harm the body through energy transfer, leading to specific physiological effects.

Vibration → Circulatory & Neurological Pathway

Mechanical vibration transmitted through hands/arms or whole body

Affects blood vessels, nerves, joints

Outcome: HAVS, vascular damage, nerve disorders



Part B — What Are Physical Hazards?

3. How physical hazards affect the human body?

Physical Hazards harm the body through energy transfer, leading to specific physiological effects.

Heat & Cold → Thermoregulation Pathway

Heat: overloads body's cooling mechanisms

Outcome: heat stress, dehydration, heat stroke

Cold: excessive heat loss

Outcome: vasoconstriction, frostbite, hypothermia



Part B — What Are Physical Hazards?

3. How physical hazards affect the human body?

Physical Hazards harm the body through energy transfer, leading to specific physiological effects.

Radiation → Tissue/Cellular Pathway

Ionising: DNA ionisation → cell damage

Non-ionising: thermal or photochemical effects

Outcome: burns, cataracts, cancer risk



Part B — What Are Physical Hazards?

3. How physical hazards affect the human body?

Physical Hazards harm the body through energy transfer, leading to specific physiological effects.

Mechanical Hazards → Impact/Force Pathway

Contact with moving machinery or objects

Transfer of kinetic energy

Outcome: crushing, fractures, cuts, amputations



Part C — Malta Specific Legal & Regulatory Framework

1. Maltese OHSA Act (Chap. 646) — only the parts specific to physical hazards

○ **Employer obligations specifically on physical agents**

Duty to ensure workers are protected from risks associated with noise, vibration, radiation, thermal stress, mechanical hazards, and other physical agents. Obligation to carry out risk assessments, identify physical hazards, and implement preventive measures. Duty to provide safe equipment, maintain workplaces, and ensure physical agents remain within safe levels.

Part C — Malta Specific Legal & Regulatory Framework

1. Maltese OHSA Act (Chap. 646) — only the parts specific to physical hazards

○ **Requirements for measurement & monitoring**

Employers must measure and evaluate exposure to physical agents whenever risks are present.

Measurement must follow ISO/EN standards and be carried out by competent persons.

Monitoring frequency increases if exposure levels approach action values or if changes in equipment, processes, or layout affect exposure



Part C — Malta Specific Legal & Regulatory Framework

1. Maltese OHSA Act (Chap. 646) — only the parts specific to physical hazards

○ **Competence & training duties**

Employers must provide information, instruction, and training specifically regarding risks from physical hazards.

Workers must be trained on instrumentation, safe work procedures, early signs of over-exposure, and emergency measures.

Only competent personnel may perform physical hazard measurements or operate equipment with inherent physical risks.



Part C — Malta Specific Legal & Regulatory Framework

1. Maltese OHSA Act (Chap. 646) — only the parts specific to physical hazards

○ **Enforcement**

OHSA Malta has authority to enter workplaces, conduct inspections, review exposure data, and issue improvement or prohibition notices.

Non-compliance can lead to administrative fines, legal action, or shutdown of unsafe operations.

Employers must cooperate fully with inspectors and maintain clear measurement/monitoring records.



Part C — Malta Specific Legal & Regulatory Framework

2. Subsidiary Legislation (focus on physical agents only)

- Noise Regulations (SL 646.20)
- Vibration Regulations (SL 646.21)
- Optical Radiation (SL 646.22)
- Electromagnetic Fields (SL 646.23)
- Minimum H&S workplace requirements (when relevant) (SL 646.08)

1. Measurement obligations
2. Action values & limit values
3. Required controls
4. Worker information/training

Part C — Malta Specific Legal & Regulatory Framework

3. OHSA Malta's enforcement role

- Inspection practice
- Industry priority sectors
- Common non compliances in Malta
- Use of guidance documents



Part C — Malta Specific Legal & Regulatory Framework

Inspection practice – What OHSA Actually does?

- Routine and targeted inspections focusing on physical agents (noise, vibration, optical radiation, EMF).
- Verification of risk assessments, exposure measurements, and instrument calibration records.
- Interviews with workers to confirm training, PPE use, and awareness of physical hazards.
- On-site observation of machinery, noise sources, thermal environments, lighting levels, and EMF-emitting equipment.



Part C — Malta Specific Legal & Regulatory Framework

Industry priority sectors

- Construction: vibration, noise, machinery hazards
- Manufacturing & workshops: noise, mechanical hazards
- Shipyards: welding radiation, noise, vibration
- Hospitality & commercial kitchens: heat stress, ventilation
- Hospitals/clinics: EMF (MRI), optical radiation (UV disinfection)
- Warehousing & logistics: lighting, noise, vehicle vibration



Part C — Malta Specific Legal & Regulatory Framework

Common non compliances in Malta

- No or poor-quality risk assessments for physical agents
- Exposure measurements not done, done incorrectly, or not repeated
- Workers not trained on noise/vibration/heat risks
- Lack of engineering controls (poor ventilation, no noise dampening, no guarding)
- Missing or poorly planned health surveillance (e.g., audiometry for noise)
- Inadequate lighting assessments
- PPE provided but not enforced or incorrect for exposure level



Part C — Malta Specific Legal & Regulatory Framework

Use of Guidance Documents

- OHSA uses and promotes EU Agency for Safety & Health at Work (EU-OSHA) guides.
- Inspectors refer to ISO/EN standards when checking measurement methods and compliance.
- Sectoral guidance exists (construction, noise, machinery, heat stress).
- Guidance documents support enforcement but also help employers achieve compliance proactively.



Part D — EU Framework for Physical Agents

1. Physical Agents Directives

- Noise 2003/10/EC
- Vibration 2002/44/EC
- Optical Radiation 2006/25/EC
- EMF 2013/35/EU

2. How these are transposed via Maltese Subsidiary Legislation

3. Minimum requirements vs national obligations

Where Malta may go stricter or equal to EU minimums.

Part E — International Standards Supporting Physical Hazard Management

A. ISO & EN standards relevant to physical agents

1. ISO 9612 (Noise exposure measurement)
2. ISO 5349 (Vibration measurement)
3. EN 14255 (Optical radiation)
4. ISO 7730 (Thermal comfort)
5. EN 12464 (Lighting)



Part E — International Standards Supporting Physical Hazard Management

1. ISO 9612 — Noise Exposure Measurement

Full title: Acoustics — Determination of occupational noise exposure

Main scope:

1. Provides a standardised method for measuring and calculating workers' daily noise exposure (LEX,8h).
2. Establishes requirements for:
3. Measurement instruments
4. Sampling strategy: Work-task–based noise assessments
5. Reporting exposure results
6. **Used for:** compliance with noise regulations, action values, and hearing conservation programs.

Part E — International Standards Supporting Physical Hazard Management

2. ISO 5349 — Vibration Measurement (Hand–Arm Vibration)

Full title: Mechanical vibration — Measurement and evaluation of human exposure to hand-transmitted vibration

Main scope:

1. Instrumentation requirements
2. How to measure the vibration transmitted to the hand
3. Frequency weighting
4. Daily exposure calculations
5. Provides the scientific basis for evaluating risk of HAVS (Hand-Arm Vibration Syndrome).
6. **Used for:** compliance with EU Vibration Directive, tool assessments, and HAVS prevention.



Part E — International Standards Supporting Physical Hazard Management

3. EN 14255 — Measurement of Optical Radiation

Full title: Measurement and assessment of personal exposures to incoherent optical radiation in workplace environments

Main scope:

1. Describes how to measure workers' exposure to artificial optical radiation (AOR), including:
 - UV radiation
 - Visible light
 - Infrared radiation
2. Specifies measurement techniques, photobiological weighting functions, and exposure limits.
3. **Used for:** ensuring compliance with the Artificial Optical Radiation Directive.

Part E — International Standards Supporting Physical Hazard Management

4. ISO 7730 — Thermal Comfort

Full title: Ergonomics of the thermal environment — Analytical determination and interpretation of thermal comfort using PMV and PPD indices

Main scope:

1. Defines how to assess thermal comfort in indoor environments.
2. Introduces well-known indices:
3. PMV (Predicted Mean Vote)
4. PPD (Predicted Percentage Dissatisfied)
5. Covers environmental and personal factors:
6. Air temperature; Humidity; Air speed; Clothing insulation; Metabolic rate
3. **Used for:** Designing comfortable workplaces, HVAC design, office ergonomics.



Part E — International Standards Supporting Physical Hazard Management

5. EN 12464 — Lighting of Workplaces

Full title: Light and lighting — Lighting of work places

Main scope:

1. Sets minimum lighting requirements for indoor workplaces.
2. Defines: Minimum lux levels for each task
3. Glare limits
4. Uniformity
5. Colour rendering
6. Visual comfort criteria
7. Ensures lighting is adequate for safety, accuracy, productivity, and wellbeing.
8. **Used for:** Designing comfortable workplaces, HVAC design, office ergonomics

Part F — Linking Physical Hazards to Risk Management

1. Why Measurement Is Essential in Risk Assessment for Physical Hazards

Physical hazards differ from chemical, biological, and ergonomic hazards in one crucial way:

Their risk cannot be evaluated by observation alone — you must measure physical energy using calibrated instruments.

Why?



Why Measurement Is Essential in Risk Assessment for Physical Hazards

Physical hazards have invisible or non-obvious exposure levels

1. Noise exposure cannot be assessed by “how loud it feels.”
2. Vibration amplitude and frequency cannot be perceived accurately by workers.
3. UV/IR radiation is invisible.
4. EMF cannot be detected without meters.
5. Heat stress risk depends on WBGT, humidity, air movement — not temperature alone.

Without instruments, the assessor has no accurate exposure value

- You cannot compare exposure against action values or limit values in Maltese S.L. 646 series regulations.
- You cannot determine compliance with EU Physical Agents Directives.



Why Measurement Is Essential in Risk Assessment for Physical Hazards

Legislation requires measurement to trigger legal duties

Under the Health and Safety at Work Act (Chap. 646) and its subsidiary regulations, employers must:

1. Measure noise, vibration, optical radiation, and EMF exposures
2. Compare them to legal exposure limits
3. Take actions when thresholds are exceeded
4. Since these limits are numerical, measurement is mandatory.



Why Measurement Is Essential in Risk Assessment for Physical Hazards

Physical hazards vary throughout the workday

Exposure depends on:

1. Duration
2. Distance
3. Work task
4. Tools used
5. Work cycles
6. Work environment

Only measurement can capture these variations accurately



Why Physical Hazards Cannot Be Assessed Without Instruments

Noise

1. The ear is not a measuring device.
2. Two sounds with the same “loudness” sensation can have different energy levels.
3. Exposure must be measured in dB(A) LEX,8h according to ISO 9612.

Vibration

1. The body cannot sense vibration levels accurately, especially harmful frequencies.
2. Exposure must be recorded using accelerometers and ISO 5349/ISO 2631 methods

Why Physical Hazards Cannot Be Assessed Without Instruments

Heat Stress

Temperature alone is meaningless.

Heat stress is influenced by humidity, radiant heat, clothing, metabolic rate → measured with WBGT meters and ISO 7243 methods.

Radiation (UV/IR/RF/ionising)

Most radiation cannot be seen, felt, or detected without specialised equipment.

Exposure must be measured against optical radiation or EMF standards (EN 14255, IEC norms).



Why Physical Hazards Cannot Be Assessed Without Instruments

Lighting

The human eye adapts, so perception is unreliable.

Illumination must be measured in lux using a lux meter per EN 12464.

Mechanical Hazards

Even though you can see the machine, you cannot visually assess:

1. Impact energy
2. Ejection velocity
3. Reaction time of light curtains → Measurement and testing are needed

Why This Module Follows the RA → Measurement → Controls Logic

Step 1 — Risk Assessment (RA): Identify the Hazard (Risk Management module)

For physical hazards, the RA step answers:

1. What physical hazard exists?
2. Who is exposed?
3. Under what conditions?
4. This identifies the need for measurement.



Why This Module Follows the RA → Measurement → Controls Logic

Step 2 — Measurement: Quantify the Exposure

1. Which instrument to use?
2. How to measure correctly?
3. Which ISO/EN standard applies?
4. How to interpret the results?
5. How to compare to Maltese/EU action values and limit values?

Measurement transforms the RA from a guess to a legal and scientific evaluation.



Why This Module Follows the RA → Measurement → Controls Logic

Step 3 — Controls: Apply Engineering, Administrative, and PPE Measures

Control decisions must be based on measured exposure:

1. If noise exposure > 85 dB(A): hearing surveillance
2. If noise exposure > 85 dB(A): implement controls, provide hearing protection
3. If vibration exposure > EAV: change tools or reduce exposure
4. If lighting < required lux: redesign illumination
5. If heat index exceeds threshold: adjust work/rest cycles

You cannot apply the correct control level without the correct measurement



Summary: Why Measurement Is Essential in Physical Hazard RA

Physical hazards = energy hazards

1. Risk cannot be judged by the senses
2. Exposure must be measured against legal limits
3. Instruments + ISO/EN standards = reliability and compliance

RA → Measurement → Controls

1. Identify the hazard (RA)
2. Quantify exposure (measurement)
3. Select appropriate controls based on results

Without measurement → no compliance, no legal defence, no ALARP.



1. What is a physical hazard?
2. How is a physical hazard different from a chemical hazard?
3. Can physical hazards be assessed without instruments?
4. Name three common physical hazards in Maltese workplaces.



5. Why do physical hazards often go unnoticed in the workplace?
6. Who enforces physical hazard regulations in Malta?
7. Why can't noise exposure be judged by "how loud it sounds"?
8. Which physical hazard requires a lux meter to measure exposure?

9. What happens if a workplace ignores physical hazard regulations?
10. What are “exposure pathways” for physical hazards?
11. Which physical hazard requires the use of an accelerometer for proper measurement?
12. Why is heat stress more than just high temperature?



13. What is one key duty of employers under the new Health and Safety at Work Act (Chap. 646) regarding physical hazards?
14. Why is ionising radiation considered especially dangerous?
15. Why is lighting considered a physical hazard?
16. Which international organisation issues Codes of Practice for managing physical hazards like noise, vibration, heat, and radiation?

17. Give an example of a mechanical hazard.
18. Do EU physical agent directives set minimum or maximum requirements?
19. Why does the body struggle in poorly ventilated hot environments?
20. What physical hazard is often overlooked in office environments?

Next: Lecture 2: Measurement & Monitoring Techniques for Physical Hazards

Students learn the essential measurement and monitoring techniques used for physical hazards.

The lecture covers instruments such as sound-level meters, noise dosimeters, vibration meters, WBGT devices, light meters, and radiation detectors.

Concepts include measurement strategies, sampling periods, calibration, common errors, and interpreting exposure metrics.

This foundational technical session prepares students for the hazard-specific lectures that follow.

