1.4 Design and justify comprehensive physical hazard control strategies

Learning Outcome

The learner should be able to design, justify and integrate proportionate control measures for physical hazards, using the hierarchy of control and considering the nature of the hazard, level of exposure, workforce characteristics and effectiveness of existing controls.

The objective is not simply to identify a control measure. The learner must be able to explain why the selected controls are appropriate, how they work together, and why the level of control is proportionate to the risk.

1. Applying the Hierarchy of Control

The hierarchy of control provides the preferred sequence for reducing exposure:
Elimination → Substitution → Engineering controls → Administrative controls → PPE
The principle is that controls acting directly on the hazard or exposure pathway are generally preferred over controls that depend heavily on worker behaviour.
Example – Noise
Instead of immediately issuing hearing protection, consider:

- Eliminating the noisy process.
- Replacing equipment with a quieter alternative.
- Enclosing the noise source.
- Installing acoustic barriers.
- Separating workers from the source.
- Limiting exposure time.
- Providing suitable hearing protection.

The strategy should be based on the actual risk and feasibility, rather than automatically selecting the lowest level of the hierarchy.

2. Engineering Controls

Engineering controls are designed to reduce exposure through changes to equipment, processes or the workplace environment.

Examples include:

Noise

- Acoustic enclosure.
- Sound-absorbing materials.
- Equipment isolation.
- Remote operation.

Vibration

- Low-vibration tools.
- Vibration isolation.
- Improved equipment maintenance.
- Mechanical damping.

2. Engineering Controls

Thermal stress

- Ventilation.
- Cooling systems.
- Heat shields.
- Insulation of hot surfaces.
- Mechanisation or remote operation.

Radiation

- Shielding.
- Interlocks.
- Enclosure.
- Remote operation.
- Restricted access.

Engineering controls are often valuable because they can reduce exposure without requiring continuous worker action.

However, their effectiveness must be verified through inspection, testing and, where appropriate, repeat exposure monitoring.

3. Administrative Controls

Administrative controls reduce risk through how work is organised and managed.
Examples include:

- Limiting exposure duration.
- Job rotation where appropriate.
- Scheduling high-risk work during cooler periods.
- Establishing safe operating procedures.
- Restricting access to hazardous areas.
- Training and competency requirements.
- Warning signs and information.
- Preventive maintenance programmes.
- Exposure records and monitoring programmes.

Administrative controls can be useful, but they often depend on workers consistently following procedures.
Therefore, they should not unnecessarily replace more reliable engineering solutions.

4. Personal Protective Equipment

PPE provides protection to the individual when residual risk remains after other controls have been applied.

Examples include:

- Hearing protection for excessive noise.
- Anti-vibration gloves where appropriate for vibration-related tasks.
- Protective clothing for thermal hazards.
- Face/eye protection against radiation hazards.
- Appropriate respiratory protection where physical hazards occur alongside airborne contaminants.

PPE selection should consider:

- Compatibility with the hazard.
- Correct fit.
- Comfort and usability.
- Maintenance.
- Compatibility with other PPE.
- Duration of use.
- Worker behaviour and compliance.

5. Integrating Multiple Control Measures

Complex workplaces often require several controls working together.
For example, workers using high-vibration equipment may be protected through:

Engineering: low-vibration equipment and proper maintenance
Administrative: limiting exposure time and task planning
Monitoring: periodic exposure assessment
PPE: suitable protective equipment where appropriate
Health surveillance: where required by the risk and applicable requirements
This layered approach is often called a combination or integrated control strategy.
Its advantage is that if one control becomes less effective, other measures may still provide protection.

6. Justifying Controls Based on Risk and Proportionality

Control measures should be justified using evidence rather than preference.
Relevant factors include:

- Severity of potential harm.
- Magnitude and duration of exposure.
- Number of workers exposed.
- Frequency of exposure.
- Reliability of existing controls.
- Legal requirements.
- Technical feasibility.
- Available safer alternatives.
- Residual risk after controls are applied.
- Cost in relation to the level of risk reduction achieved.

For example, if monitoring demonstrates very high noise exposure from an old machine, simply providing better hearing protection may not be a proportionate long-term strategy if the machine can reasonably be replaced with a quieter alternative.

7. Verification of Control Effectiveness

Designing a control is not the end of the process.
After implementation, the organisation should determine whether the control actually works.
This may involve:

- Inspection.
- Functional testing.
- Maintenance records.
- Worker feedback.
- Exposure monitoring.
- Trend analysis.
- Review of incidents or symptoms.

Example
A manufacturing company installs acoustic enclosure around a noisy machine.
The organisation should not simply assume that the risk has been controlled. Follow-up noise measurements should establish whether worker exposure has actually reduced.

8. Practical Case Study – Heat Stress

Workers in a manufacturing plant are exposed to high temperatures around a furnace.
Initial assessment
Exposure assessment identifies significant heat stress during certain production tasks.
Control strategy
Engineering

- Improve ventilation.
- Install radiant heat shielding.
- Mechanise high-heat tasks where possible.

Administrative

- Provide work/rest arrangements.
- Schedule demanding tasks appropriately.
- Provide hydration and acclimatisation arrangements.
- Train workers and supervisors to recognise heat illness.

8. Practical Case Study – Heat Stress

PPE

- Appropriate protective clothing where necessary.

Justification

Engineering measures address the heat source and workplace environment, while administrative arrangements manage remaining exposure. PPE provides additional protection where residual risk remains.

The strategy is therefore more robust than relying on a single measure.

Critical Evaluation

A comprehensive physical hazard control strategy must be risk-based, integrated and proportionate.
A common weakness is selecting controls because they are easy to implement rather than because they provide the greatest practical reduction in exposure.

For example:
"Provide PPE" is not a complete control strategy.

A stronger strategy asks:
Can the hazard be eliminated? Can exposure be reduced at source? Can the process be engineered? What administrative controls are necessary? What residual risk remains? Is PPE still required?
Controls must also be reviewed when processes, equipment, workforce or exposure conditions change.

Key Takeaways

- Use the hierarchy of control when designing physical hazard controls.
- Prioritise measures that eliminate or reduce exposure at source.
- Engineering, administrative controls and PPE should be integrated where necessary.
- Controls should be justified according to risk, effectiveness, legal requirements and proportionality.
- Always verify control effectiveness and refine the strategy when evidence shows that performance is inadequate.

Thank you