NEBOSH International Diploma

Unit IA - Managing Health and Safety

Unit IB - Hazardous Substances and Agents

Unit IC - Workplace and Work Equipment Safety

SAMPLE MATERIAL

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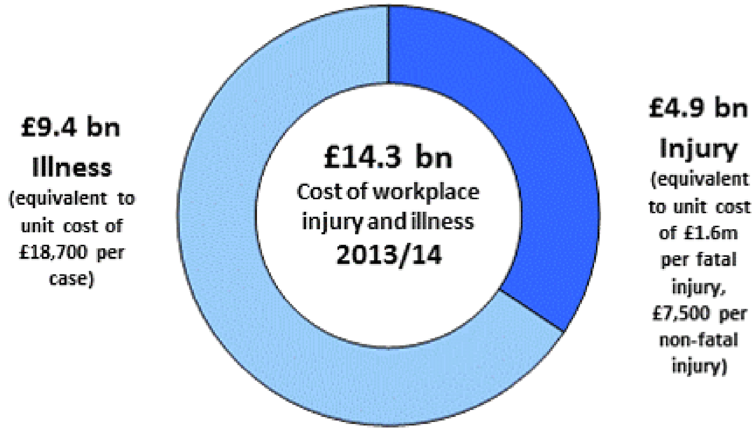

Figure IA1-6: Estimates of breakdown of costs to society of workplace injury and ill-health 2013/14. *Source: UK, HSE Cost to Britain model.*

The UK HSE also provided data in 2013/14 on the estimated costs of different types of case.

	Non-financial human cost	***Financial cost***	***Total cost per case***
Fatal injuries	£1,153,000	£421,600	£1,575,000
Non-fatal injuries	£4,600	£2,900	£7,500
Ill-health	£9,900	£8,700	£18,700

Figure IA1-7: Estimates of costs to society of different cases of workplace injury and ill-health 2013/14. *Source: UK, HSE Cost to Britain model.*

INSURED AND UNINSURED COSTS

Many case studies over recent years have illustrated the difference between insured costs and uninsured costs. It has been shown in the case studies that uninsured costs were often between 8 and 36 times greater than the insured costs.

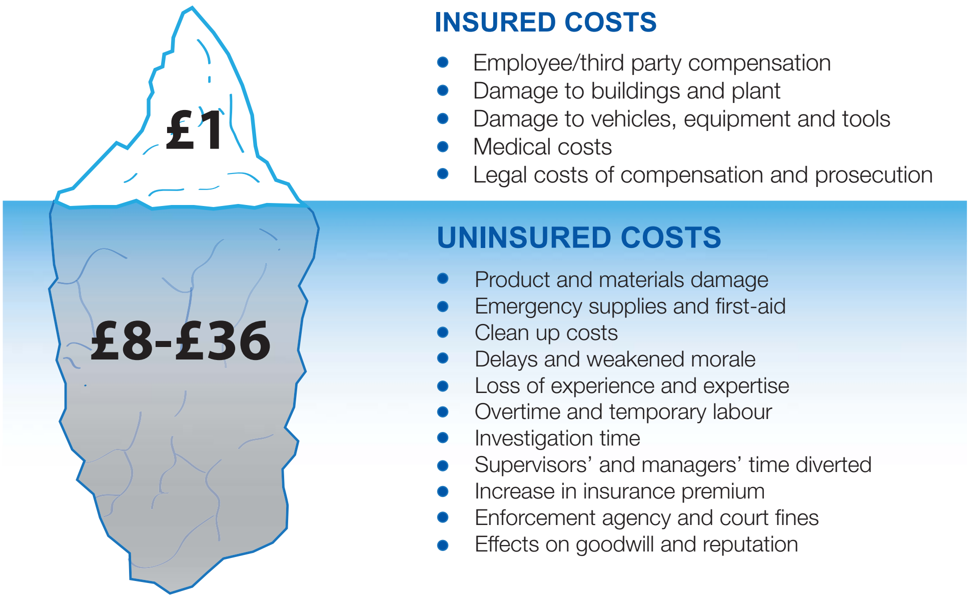

Figure IA1-8: Main insured and uninsured costs, typical ratio of costs. *Source: RMS/UK, HSE HSG96 (no longer available).*

Costs relating to injury and ill-health may also be classified on the basis of whether they are direct costs or indirect costs.

Direct costs

Direct costs include:

- Lost time of injured worker and any continued payments to worker or family.
- Damage to equipment, tools, property, plant or materials.
- Medical or first-aid costs.
- Time and materials to clean up after the accident.
- Insurance, indemnity or compensation payments.
- Court costs.
- Fines.

Figure IA9-3: The distinction between leadership and management. *Source: RMS.*

The need to adopt to different management styles dependent on any given situation

Many managers assume that leadership style is a function of their personality rather than a strategic decision they can make. The manager should be able to choose the style that has most effect in the situation presented.

There are many different models of management styles. However, Daniel Goleman measured the impact of 6 different styles of management and leadership.

The six different styles of leadership following Goleman (2000) are:

- Coercive: relatively aggressive style that demands compliance, the style works best in crisis situations i.e. immediately following an accident, where decisive management is required.
- Authoritative: it is considered to be the most effective motivating style of leadership that drives people to improve performance. Works best when a new vision is required or a new safe system of work developed.
- Affiliative: a style that focuses on people, it values employees and their emotions, rather than their objectives. Works best when the manager is aware the team is operating in stressful situations, such as the aftermath of a fire.
- Democratic: a democratic leader builds trust and respect by listening to every member's opinions. The style works best when the manager wants everyone in the team to contribute i.e. risk profiling of an organisation.
- Pacesetting: a leader sets high standards and wants the goal to be reached in an excellent and fast way. Works best with highly motivated, competent teams such as engineers when reviewing a safe system of work in the oil processing industry.
- Coaching: a coaching leader helps employees to identify their strengths and weaknesses. Works best when the manager is improving the performance of the team i.e. compliance with a standard or convention.

Development, implementation, maintenance and evaluation of health and safety management systems

ROLE (AND FUNCTION) OF HEALTH AND SAFETY PRACTITIONERS

The role of the health and safety practitioner is to support line management in meeting their responsibilities by:

- Providing information and advice.
- Supporting line management with the coordination of health and safety effort.
- Monitoring the effectiveness of actions to meet responsibilities.

The functions of the health and safety practitioner include activities to:

- Identify problems (including hazards).
- Assess the need for action.
- Assist with the assessment of risks.
- Design and develop strategies and plans.
- Advise on relevant current best practice for prevention.
- Present themselves and their advice in an independent manner.
- Promote and communicate health, safety and welfare advances and practices.
- Assist with the implementation of these strategies and plans.
- Evaluate their effectiveness.
- Maintain records relating to health and safety performance.

For efficient operation, exhaust ventilation should be located as close as possible to the source of dust, by the use of captor hoods, booths or enclosures. Local exhaust systems should be designed to collect and remove all dust-laden air. Openings in the enclosures should be as small as possible, while still allowing access to the necessary work operation.

In the case of captor hoods and booths, the ventilation equipment should be so constructed that air turbulence and eddies, created by the work process or by the workers, do not prevent the effective removal of dust.

PERSONAL PROTECTION

Respiratory protective equipment (RPE)

- The provision and use of respiratory protective equipment (RPE) should be regarded only as a temporary or emergency measure and not as an alternative to technical control.
- A sufficient and suitable supply of equipment should be available in the workplace.
- In the UK, for example, it is a requirement of the law under the Control of Asbestos Regulations 2012, that suitable RPE is provided by the employer which reduces asbestos exposure 'so far as is reasonably practicable'. Supporting this regulation is an Approved Code of Practice (ACOP) which recommend that employers undertake respiratory face-piece fit testing for their workers.
- Such equipment should be provided for all workers employed in any situation where levels of airborne asbestos fibre exceed, or are liable to exceed, the exposure limits.
- Workers should be informed when concentrations of airborne asbestos fibre reach such levels.
- When workers have been so informed, they should use the equipment provided.
- Workers required to wear protective equipment should be fully instructed in its use.
- Employers should provide supervision, to ensure that the equipment is properly used.
- All respiratory equipment should be provided and maintained by the employer without cost to the worker.

Face piece fit testing is a method for ensuring that respiratory protective equipment (RPE) supplied by the employer provides an adequate seal that prevents exposure and takes into account facial features.

The fit test will ensure that only correctly fitted RPE will be used to prevent exposure.

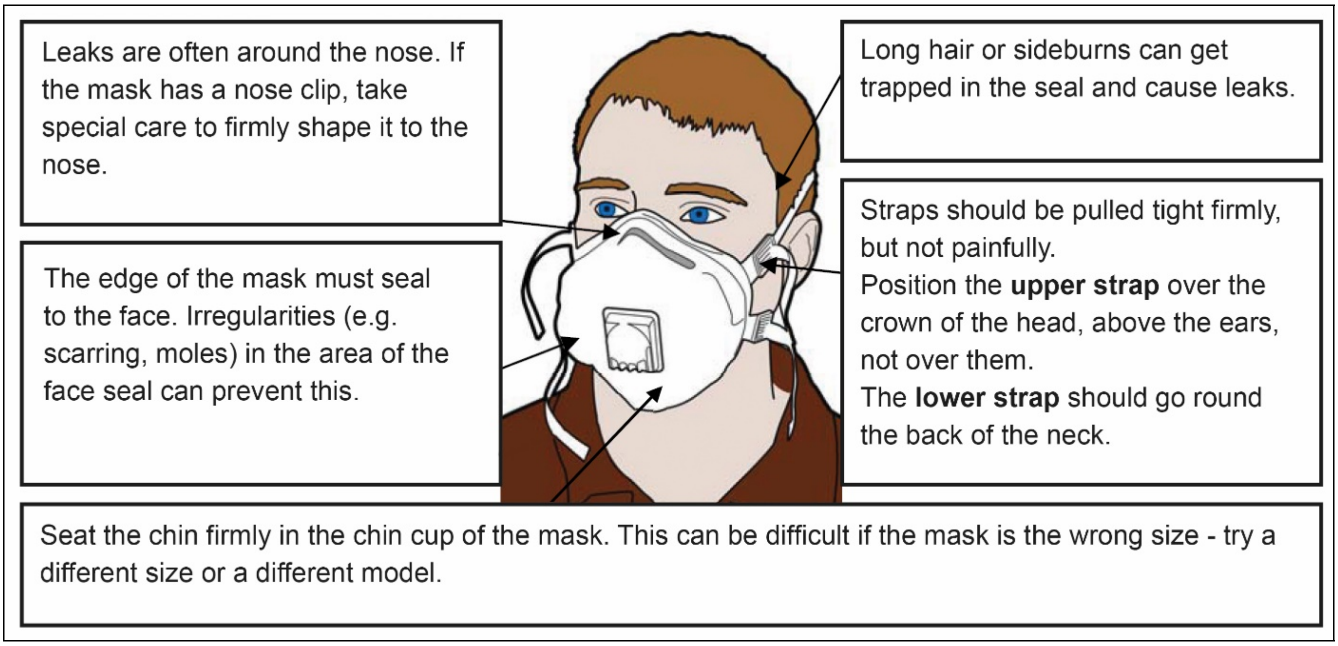

Figure IB3-6: Some of the frequent problems with fitting and possible solutions for filtering facepiece respirators. *Source: UK, HSE.*

A fit test is not a substitute for correct and careful day-to-day fitting of the face piece. The latter should always include a pre-use fit check.

A repeat fit test should be conducted in the following circumstances:

1) Where the wearer:
   a) Loses or gains weight.
   b) Undergoes any substantial dental work.
   c) Develops any facial changes (scars, moles, etc.) around the face seal area.
2) If the employer's health and safety policy requires it.

IB7.1 - The nature and different types of ionising and non-ionising radiation

The distinction between ionising and non-ionising radiation

The part of the electromagnetic spectrum with greatest energy is where the gamma rays and the X-rays are. They are so powerful that they are capable of removing the electron from an atom of material they encounter, a process that is called ionisation.

These powerful rays are known as ionising radiation. The radiation from the lower energy part of the electromagnetic spectrum, ultraviolet (UV), visible light, infrared (IR), microwaves and radio waves, do not contain enough energy to ionise and are therefore known as non-ionising radiation. Radiation can therefore be classified in terms of its energy into two types: ***ionising*** and ***non-ionising***.

There is also a type of ionising radiation that is not electromagnetic waves, but is particulate. The most common particles of ionising radiation are known as alpha (α), beta (β) and neutron radiation.

Note: Other types of radiation exist, such as positrons (β+), thermal neutrons, fast neutrons and protons, but are beyond the scope of this Element.

Ionising radiation can be defined as radiation, typically alpha and beta particles, and gamma and X-rays, which has sufficient energy to produce ions by interacting with matter. Non-ionising radiation can be defined as radiation that does not possess sufficient energy to cause the ionisation of matter.

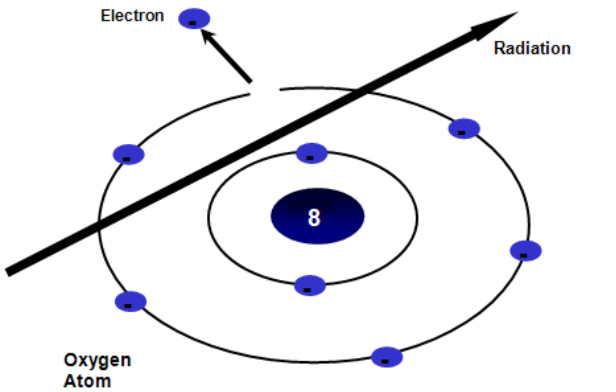

Figure IB7-1: Ionisation. Source: RMS.

Ionising radiation has sufficient energy to dislodge electrons from atoms thus changing the chemical properties of the substance it interacts with. Ionising radiation includes alpha particles, beta particles, gamma rays, X-rays and cosmic rays.

Figure IB7-2: Definition of ionising radiation. *Source: London Health Observatory.*

Non-ionising radiation (NIR) is the term given to the part of the electromagnetic spectrum where there is insufficient quantum energy to cause ionisations in living matter. It includes static and power frequency fields, radiofrequencies, microwaves, infrared, visible and ultraviolet radiation.

Figure IB7-3: Definition of non-ionising radiation. *Source: Health Protection Agency.*

The electromagnetic spectrum

BASIC CONCEPTS - WAVELENGTH, ENERGY AND FREQUENCY

Radiation is a form of energy that is emitted by a wide variety of sources. The types of radiation are grouped and labelled according to the nature of the radiation and the amount of energy they have. One of these types of energy is transmitted by waves called electromagnetic waves.

An electromagnetic wave travels, or propagates, in a direction that is oriented at right angles to the oscillations of both the electric (E) and magnetic (B) fields, transporting energy away from the radiation source.

The two oscillating energy fields are mutually perpendicular and act in phase, as a sine wave. Electric and magnetic field vectors are not only perpendicular to each other, but are also perpendicular to the direction of wave propagation.

By convention, and to simplify illustrations, the vectors representing the electric oscillating fields of electromagnetic waves are often omitted. The resulting diagrams show a single sinusoidal electromagnetic wave.

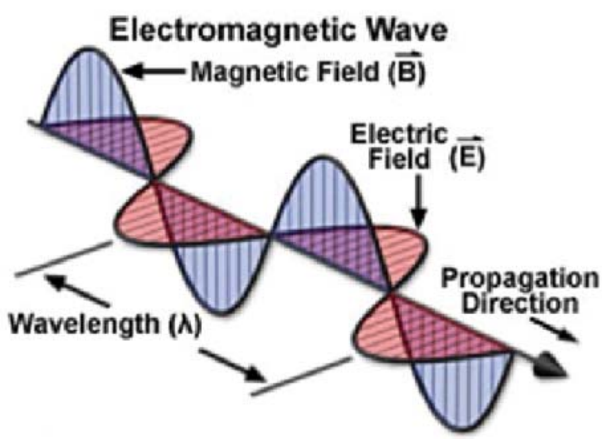

Figure IB7-4: Electromagnetic wave. Source: Olympus.

The distance between electromagnetic wave peaks is the 'wavelength'. The number of wave peaks passing a given point in one second is the 'frequency'. The distance between electromagnetic wave peaks is the 'wavelength'. The number of wave peaks passing a given point in one second is the 'frequency'.

RELATIVE DENSITY

Relative density is 'the ratio of the specific density of a substance to the specific density of a standard substance at specified conditions'. For liquids and solids, the standard is usually water at 4°C or some other specified temperature. For vapours and gases, the standard is often air at the same temperature and pressure as the substance.

For fire safety and fire protection reasons we are particularly concerned with the comparison of a flammable material and its vapours in relation to air. The vapour density of air at standard temperature and pressure is taken as 1 with a molecular weight of 28.97 grams per mole. All other gases are compared to air by dividing their molecular weights. We can therefore see that the ***relative density*** for methane when compared to air is:

$$\frac{16.04}{28.97} = 0.55 \text{ (a relative density less than 1, which makes it lighter than air).}$$

Since both units are in g/mol, relative density (the ratio of the two units) has no units; it is a pure number. The unit is used as a single comparator to determine the initial behaviour of a gas when released into the air at the same temperature, i.e. will it rise or fall.

As can be seen, the difference between the UK vapour density and relative density is significant. It is important to ensure that the relative density of a vapour is used when considering its hazards and the necessary safety measures.

Density effects - gases and vapours

Few materials have a molecular weight less than air (molecular weight of approximately 29), so under normal conditions most gases and vapours are heavier than air. Hydrogen (H_2) (molecular weight of approximately 2), methane (CH_4) (molecular weight of approximately 16) and acetylene gas (C_2H_2) (molecular weight of approximately 26) are exceptions. The higher the molecular weight of a gas/vapour, the greater its (specific) density at constant temperature.

In order to establish a reference point, air is given a specific density of 1. This enables a relative density to be established for other substances and to predict the effect of them being placed together. Flammable or explosive gas/vapours heavier than air (relative density greater than 1), such as propane (which has a relative density of 1.52 when compared to air), can spread and accumulate at a low level, for example, in pits, sumps or drains. Also, vapours less dense than air at ambient temperature may spread at low level when they are cold, because the specific density of the substance when cold could be greater than the surrounding warmer air.

Gas or vapour	***Molecular weight***	***Relative density (air)***
Air	28.97	1
Acetylene, C_2H_2	26.04	0.90
Cyclohexane, C_6H_{12}	84.16	2.91
Ethane, C_2H_6	30.07	1.04
Hydrogen, H	1.01	0.03
Methane, CH_4	16.04	0.55
Propane, C_3H_8	44.10	1.52

Figure IC2-1: Densities of flammable gases/vapours. *Source: RMS/Multiple.*

Accumulations of gas/vapour less dense than air (relative density of less than 1), for example, hydrogen and methane, can occur at high points in poorly ventilated buildings. Consideration needs to be given to work activities that represent a source of ignition when they take place where gas accumulation might occur in this way, for example, maintenance work at a height.

The relative density of a flammable vapour or gas with air is important when considering local exhaust ventilation (LEV) requirements provided to prevent a build-up of the vapour or gas; it will indicate whether LEV is required at high or low level, or both.

Case Study

Computer utilities require batteries as a source of power, A hydrogen explosion occurred in an Uninterruptible Power Source (UPS) battery room of a data processing centre. The explosion blew a 400 ft^2 hole in the roof, collapsed numerous walls and significantly damaged a large portion of the 50,000 ft^2 building. Fortunately, the computer/data centre was vacant at the time and there were no injuries. The explosion resulted from the lack of hydrogen gas (produced when lead acid batteries are charged) detection and high level ventilation equipment.

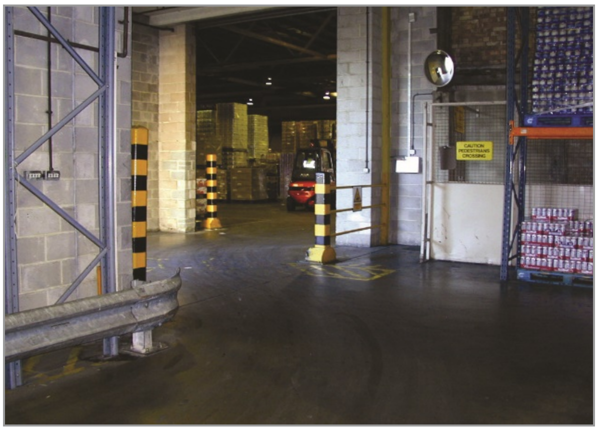

Figure IC10-13: Barriers and markings. *Source: RMS.*

Figure IC10-14: Visual warning on a dumper truck. *Source: RMS.*

Warnings of vehicle approach and reversing

Warnings may be audible or visual or a combination of each. They are used to warn that the vehicle is operating in the area, such as a flashing light on the top of a fork-lift truck or to warn of a specific movement, such as an audible warning that a large vehicle is reversing. These are designed to alert people in the area in order that they can place themselves in a position of safety. They do not provide the driver with authority to reverse the vehicle or to proceed in a work area without caution.

Control measures for reversing vehicles within the workplace include:

- Avoiding the need for vehicles to reverse (by the use of one-way and 'drive-through' systems or turning circles).
- Separation of vehicles and pedestrians as much as is practicable.
- Signs that warn of the hazard.
- Visual and audible warning systems fitted to vehicles.
- Adequate mirrors/vehicle cameras that are kept clean.
- Space to allow good visibility.
- Adequate lighting minimising sudden changes in luminance.
- Procedural measures, such as the use of trained signaller/banksman/reversing assistant.
- Refuges to protect signaller/banksman/reversing assistant.
- Appropriate site rules adequately enforced.

Site rules

It is important to establish clear and well understood site rules regarding vehicle operations. These may have to be communicated to drivers by security staff at the time they visit the site. They would often stipulate where the driver should be whilst vehicles are being loaded, where the keys to the vehicle should be, not reversing without permission and what access they have to areas of the site for such things as refreshment. Pedestrians should also know what the site rules are in order to keep themselves safe.

Site rules for pedestrians might include such things as using pedestrian exits/entrances or crossing points, not entering hazardous areas or the need to wear personal protective equipment in hazardous areas, and not walking behind a reversing vehicle. Where sites are made up of or join a highway, such as carriageway repairs on a motorway, it is important to identify who has priority - the vehicle or the pedestrian. Site rules may clarify that once the site boundary is crossed, the pedestrian has priority - this has to be clear. The site rules may be re-enforced by the provision of additional signs to clarify a speed limit and the nature of the priority of workers.

Activity

Workplace transport activities that present a risk include:

- Reversing up to structures or edges.
- Banksmen (signallers).
- Parking in car parks, hard standings or on a slope.
- Coupling and uncoupling.
- Access to 'fifth wheel' area.
- Loading and unloading.
- Loading bays including dock levellers and preventing vehicles moving.
- Dealing with shifted loads.
- Work at height on vehicles platforms and gantries.
- Trimming, sheeting and netting.

Many deaths and serious injuries involving vehicles at work happen during reversing, with poor visibility being the main cause. There are several measures that can help to reduce the risk of reversing accidents, but removing the need for reversing is the most effective.