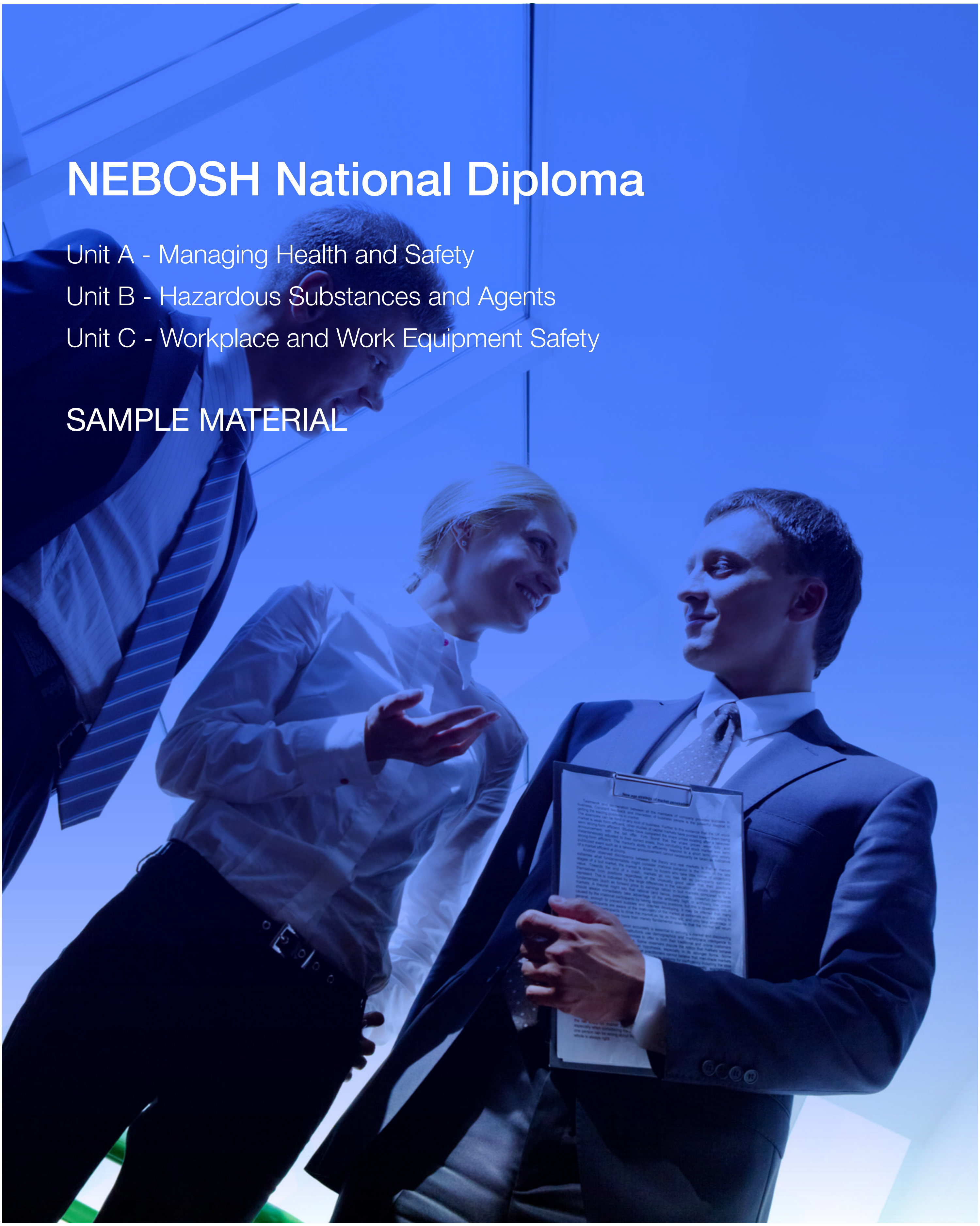

NEBOSH National Diploma

Unit A - Managing Health and Safety

Unit B - Hazardous Substances and Agents

Unit C - Workplace and Work Equipment Safety

SAMPLE MATERIAL

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Figure A1-9: The core elements. *Source: HSG65, HSE.*

Application of the Plan, Do, Check, Act cycle with reference to HSG65

The HSE has introduced a web based replacement for HSG65 - 'Successful health and safety management' which moves away from the POPMAR (Policy, Organising, Planning, Measuring Performance, Auditing and Review) model of managing health and safety to 'Plan, Do, Check, Act (PDCA)' which is closer to the framework used in management systems standards, such as OHSAS 18001 etc.

The new document is part of a set of guidance which replaced the Management of Health and Safety at Work Regulations Approved Code of Practice which was withdrawn in June 2013. The move towards Plan, Do, Check, Act is designed to achieve a better balance between the systems and behavioural aspects of management. It also introduces health and safety management which is an integral part of good management generally, rather than as a stand-alone system. Plan, Do, Check, Act is an on-going management system and should not be seen as a once only exercise.

While the comprehensive guidance document of HSG65 provides detailed explanation of the model and how it can be effectively implemented, the HSE's Industry Guide INDG275: Plan, Do, Check, Act - An Introduction to Managing for Health and Safety provides a useful summary of the model.

Figure A1-10: Plan, Do, Check, Act system. *Source: HSE.*

A5.1 - Theories/models and use of loss causation techniques

Losses result from lack of control and are revealed by loss causing events. These events may be known by a variety of names, the most common of which is 'accident'. There are many different definitions for the term accident, ranging from simple to complex. A useful definition of an accident is:

An unplanned, uncontrolled event which led to, or could have led to injury to persons, damage to plant or some other loss to the company.

Figure A5-1: Definition of an accident. *Source: RMS.*

This definition encompasses events that result in a wide range of losses and has, for a long time, helped to provide a good perspective of events with different outcomes. This has assisted greatly in encouraging people to learn from events and the subsequent prevention of accidents. The definition therefore, includes 'near misses', i.e. where no injury or damage etc. occurs. It is important not to think of injuries, damage and other losses as accidents, but rather as the results of accidents.

The following accident model is offered to illustrate the above statement: a brick falls from a height. The following consequences could result:

1) The brick falls into a pile of sand and there is no damage or injury. The brick hits an item of equipment, resulting in damage, but no injury.
2) The brick strikes a person causing a cut and bruising to the hand, this is an injury accident.
3) The brick strikes a person working directly underneath causing a fatality.

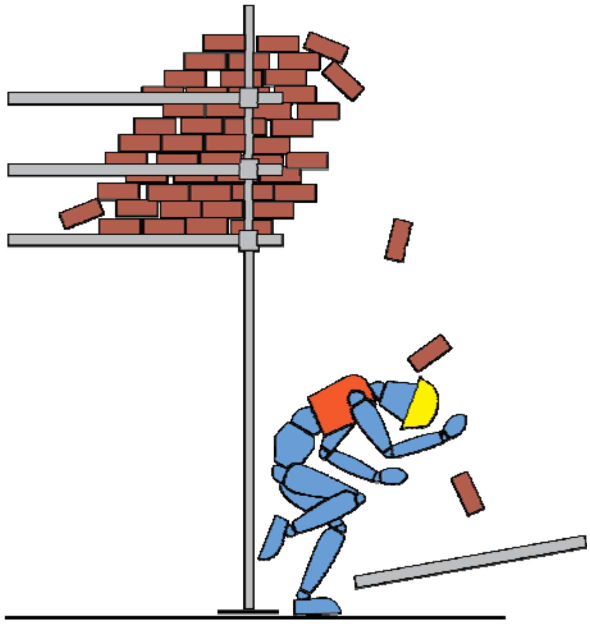

Figure A5-2: Accident. *Source: HSG245.*

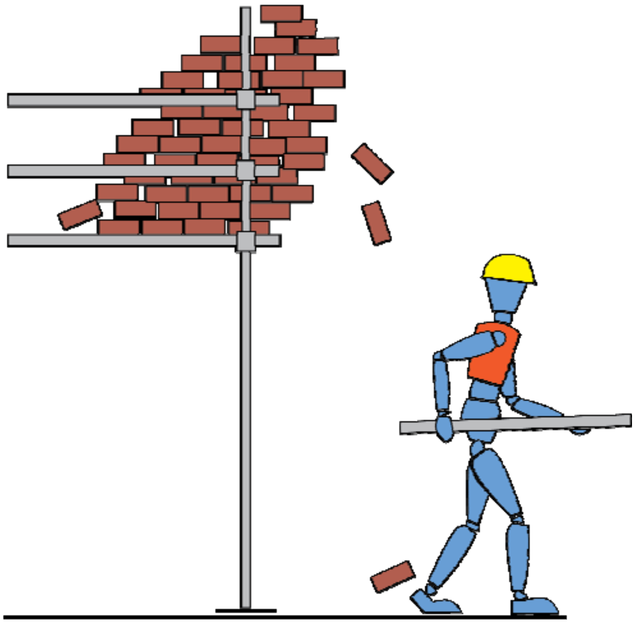

Figure A5-3: Near miss. *Source: HSG245.*

The difference between a near miss and a fatal accident in terms of time and distance can be very small indeed. It is therefore clear that the damage to persons or property is not the accident, but part of the effects of the accidents (i.e. the result or consequences).

An old adage says never waste an accident. Apart from being unpleasant and perhaps very costly, every accident constitutes an opportunity to correct some problem. For this purpose, a near miss which has the potential to cause loss is just as important as a serious injury/damage, in fact even more important if we are to avoid a future loss incident, a golden opportunity not to be missed.

In the HSE Guidance Document HSG245 'Investigating accidents and incidents', the HSE refers to an 'Adverse Event'. An adverse event includes:

- Accidents.
- Incidents.

The term 'adverse event' used by the HSE is similar to the term 'accident' used in ***figure ref A5-1*** above and encompasses events that have a wide range of outcomes. The HSE reserves the term 'accident' for events that involve harm to people.

The HSE define an Accident as:

An event that results in injury or ill-health.

Figure A5-4: Definition of an accident. *Source: HSE, HSG245.*

The HSE states that an incident includes a:

- Near miss.
- Undesired circumstance.

A decision flow chart is available from the HSE at, www.hse.gov.uk/asbestos/essentials/index.htm. If work is determined to be NNLW, the duties are:

- To notify the enforcing authority responsible for the site where the work is before work starts. (There is no minimum period).
- By 2015 all employees will have to undergo medical examinations which are repeated every three years.
- To have prepared procedures which can be put into effect should an accident, incident or emergency occur.
- To keep a register of all NNLW work for all employees.
- To record the significant findings of and comply with a risk assessment.
- To prevent or reduce exposure so far as is reasonably practicable and to take reasonable steps that all control measures are used.
- To ensure that adequate information, instruction and training is given to employees.

Typical locations where asbestos can be found

Asbestos has been widely used in building materials for a long time, though some countries have established programmes to phase out its use because of the risks to health.

As long as the asbestos-containing material (ACM) is in good condition, and is not being or going to be disturbed or damaged, there is negligible risk. But if it is disturbed or damaged, it can become a danger to health, because people may breathe in any asbestos fibres released into the air.

Workers who may be particularly at risk of being exposed to asbestos when carrying out building maintenance and repair jobs include:

- Construction and demolition contractors, roofers, electricians, painters.
- Decorators, joiners, plumbers, gas fitters, plasterers, shop fitters, heating and ventilation engineers, and surveyors.
- Anyone dealing with electronics, for example, phone and information technology (IT) engineers, and alarm installers.
- General maintenance engineers and others who work on the fabric of a building.

If asbestos is present that can be readily disturbed, is in poor condition and not managed properly, all people in the building could be put at risk.

Asbestos has been used in many parts of buildings, examples of uses and locations where asbestos can be found are shown in ***figure ref B3-4***.

Asbestos products	***What it was used for***
Sprayed asbestos (limpet).	Fire protection in ducts and to structural steelwork, fire breaks in ceiling voids etc.
Lagging.	Thermal insulation of pipes and boilers.
Asbestos insulating boards (AIB).	Fire protection, thermal insulation, wall partitions, ducts, soffits, ceiling and wall panels.
Asbestos cement products, flat or corrugated sheets.	Roofing and wall cladding, gutters, rainwater pipes, water tanks.
Certain textured coatings.	Decorative plasters, paints.
Bitumen or vinyl materials.	Roofing felt, floor and ceiling tiles.
General uses.	Vehicle brake linings, woven fires, ropes used as high temperature gaskets for furnaces, jet engines, chemical pipelines. Electrical insulation for hotplate wiring, electrical fuse wire holders and in building insulation and sound absorption. Filters for cigarettes. Artificial (chrysotile) snow effects in Hollywood films made in the USA in the 1920's and 1930's.

Figure B3-4: Examples of uses and locations where asbestos can be found. *Source: RMS.*

Sprayed coatings, lagging and insulating board are more likely to contain blue or brown asbestos. In general, materials that contain a high percentage of asbestos are more easily damaged. Asbestos insulation and lagging can contain up to 85% asbestos and are most likely to give off fibres.

Work with AIB can result in equally high fibre release if power tools are used. Asbestos cement is of lower risk, since it contains only 10-15% asbestos.

The asbestos is tightly bound into the cement and the material will only give off fibres if it is badly damaged or broken, or is worked on, for example, if it is drilled, abraded or cut.

B6.1 - Basic physical concepts relevant to noise

Definition of noise

Noise may be defined as any signal that does not convey useful information. Noise is also defined as unexpected, unpleasant or undesired. Some sounds can cause annoyance or stress and loud noise can cause damage to the ear.

The meaning of noise under the Control of Noise at Work Regulations 2005

The Control of Noise at Work Regulations (CNWR) 2005 implements the European Union Directives to protect workers from the health risks caused by noise.

They do not apply to members of the public exposed to noise from their non-work activities, or when they make an informed choice to go to noisy places or from nuisance noise.

"Any audible sound."
"Noise is a reference to the exposure of that employee to noise which arises while he is at work, or arises out of or in connection with his work."

Figure B6-1: Definition of noise. *Source: CNWR 2005 Regulation 2.*

WORKPLACE EXAMPLES OF NOISE

Workplaces where high levels of noise may be found include those where the following are present:

- Metal processing and fabrication.
- Packaging into glass or metal containers.
- Veterinary clinics and charity animal sanctuaries.
- Wood cutting and finishing.
- Grinding equipment.
- Highway repair work.
- Heavy machinery, including transport, construction and mining.
- Orchestral music.

See figure ref B6-2, which gives a range of activities with their corresponding noise levels.

Figure B6-2: Noise levels. *Source: Noise at work: HSE Guidance for employers.*

The basic concepts of sound

The ear senses sound, which is transmitted in the form of longitudinal waves travelling through a medium/substance, for example, air, water, metals. Any audible sound is noise. There is a lot of terminology with regards to sound. Key concepts of sound have been briefly defined as follows.

WAVELENGTH

Wavelength (λ) - is the distance covered during one complete cycle (i.e. the distance between wave peaks).

The relationship between wavelength and frequency is described by the formula:

$$\text{Wavelength} = \frac{\text{speed of sound}}{\text{frequency}}$$

Thus, as the speed of sound in air at normal temperature is 344 metres per second. A frequency of 20 Hz = a wavelength of 17 m and 20 kHz = 0.017 m.

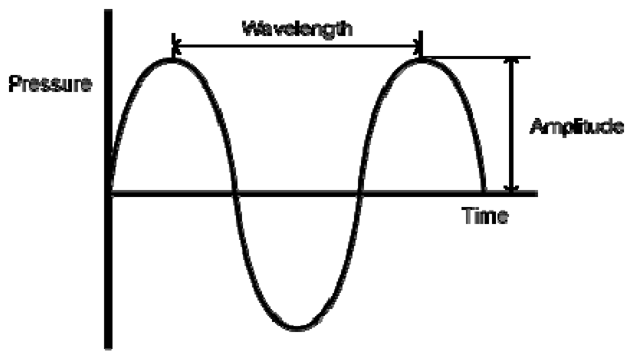

Figure B6-3: Features of a sound wave. *Source: RMS.*

AMPLITUDE

Amplitude is important in the description of a wave phenomenon such as light or sound. In general, the greater the amplitude of the wave, the more energy it transmits (for example, a brighter light or a louder sound).

FREQUENCY

Frequency is the number of cycles (completed wavelengths) that the wave makes per second, expressed in the unit Hertz (Hz). Sound may be of a single frequency (i.e. a pure tone such as a tuning fork) but is usually a complex mixture of frequencies. The normal range of human hearing is 20 - 20,000 Hz in a young healthy adult. ***Broad band noise*** is the term often used to describe occupational noise, because it contains a wide mixture of frequencies. The range of frequencies that we encounter is often divided into Octave Bands. A noise can be measured in each octave band and these levels can be used when assessing the attenuation of hearing protectors, or when diagnosing noise problems.

MAXIMUM EXPLOSION PRESSURE

The maximum explosive pressure (Pmax) is one of the explosion indices used, along with maximum rate of explosion pressure rise, to quantify the likely severity of a gas, vapour or dust explosion. Each mixture of flammable material with air will produce a different explosion pressure dependent upon the material itself and the flammable material (fuel)/air mixture. The maximum explosion pressure is reached if the mixture is at its ideal or stoichiometric mixture.

Fuel	**Lower explosive limit (kg/m^3)**	**Maximum explosive pressure**
Coal	0.035	780 kPa (7.8 bar)
Aluminium	0.035	650 kPa (6.5 bar)
Starch	0.045	1,100 kPa (11.0 bar)

Figure C2-5: Maximum explosion pressures. *Source: FST.*

RATE OF PRESSURE RISE

When considering the severity of an explosion another consideration would be the rate of pressure rise (K_{st}). The slower the initial pressure rises within an explosion, the greater the chance of detecting the pressure rise and providing a form of intervention that limits the effects of the explosion, for example, inerting to suppress, or providing sufficient blow out relief panels to vent the explosive force.

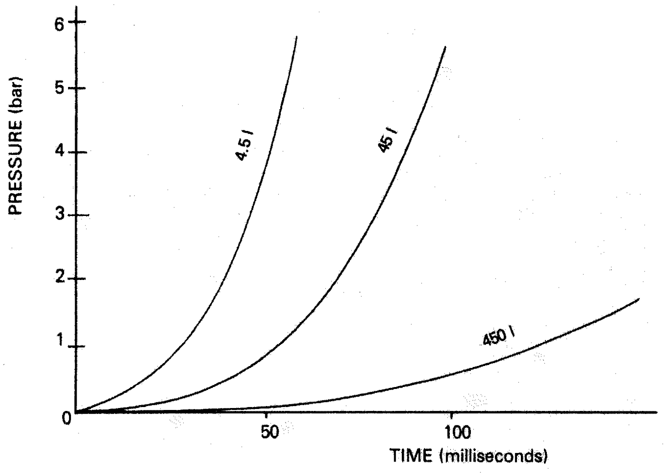

Figure C2-6: Explosion pressure curves for hexane/air mixtures in vessels of different sizes. *Source: Ambiguous.*

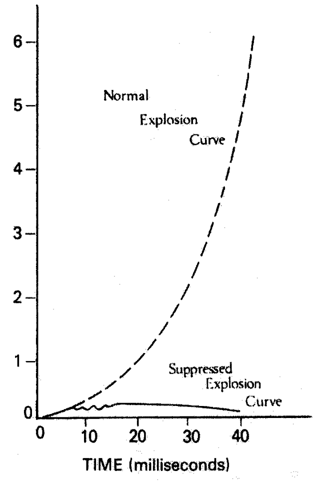

Figure C2-7: Suppressed explosion curve for a hexane/air mixture in a one gallon vessel. *Source: Ambiguous.*

The fire triangle

The fire triangle is a simple approach that depicts fire as having three essential components: fuel, oxygen and heat. The oxygen is contained in the air of most workplaces and anything that burns is a fuel for a fire, for example:

- Flammable liquids.
- Flammable gases.
- Flammable chemicals.
- Wood.
- Paper and card.
- Plastics, rubber and foam.
- Loose packing materials.
- Waste materials.

When these three components combine in the right proportions, the chemical reaction of combustion takes place.

The three components are portrayed as coming together in a triangle, which shows their dependency on each other for the combustion process. This approach is useful when considering the components needed to make a fire and how they are extinguished. If one or more of the components of a fire is removed, the fire will be extinguished.

This can be done by:

- ***Cooling*** the fire to remove the heat.
- ***Starving*** the fire of fuel.
- ***Smothering*** the fire by limiting its oxygen supply.

Figure C2-8: The fire triangle. *Source: CorelDraw! 5.0 clipart.*

Where there is a high risk of electric shock, as with hand lamps, soldering irons, and portable tools in adverse conditions, the use of separated extra low voltage (maximum 50 volts AC/125 volts DC ripple free) is recommended.

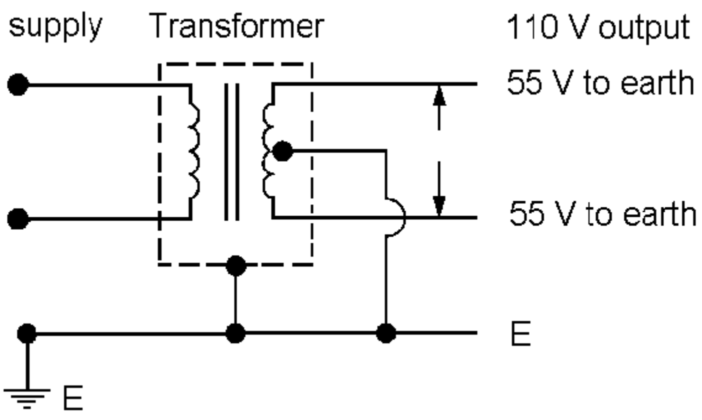

Figure C8-20: UK standard reduced voltage system. *Source: G Self.*

Excess current protection

Excess current is also called over current. There are two types of over current. These are overload and fault current.

Overload occurs in a normally healthy electrical system when equipment has been mechanically overloaded beyond its safe operating load or an excessive number of electrical appliances have been added to the system creating excessive demands. Two things normally happen. Due to the extra current demanded the temperature of the conductors rapidly rises. If left undetected, this will lead to a breakdown in insulation resistance and eventually a fire.

Fault current occurs when an excess of current flows between conductors or from one or more conductors to earth due to a fault condition. The consequences may generate sufficient heat to cause fire and in this case the overload protection will normally take effect.

Under certain conditions only a small fault current will be generated, but this may be sufficient to apply a live potential to the exposed casing or metalwork.

Excess current protection devices rely on the detection of the excess current and disconnection within designed boundaries. The current level for disconnection will always be greater than the normal operating current.

FUSES

These work on the thermal effect produced by the current flow and are designed to melt at predetermined temperatures that are proportional to a level of current flow. There are two types of fuse commonly used - cartridge fuses and high breaking capacity fuses (HBC).

Cartridge fuse

The body of the fuse can be either ceramic or glass with metal end caps, to which the fuse element is connected. The fuse sometimes is filled with silica sand.

Advantage

- Small physical size.
- No mechanical moving parts.
- Accurate current rating.
- Little deterioration over time.

Disadvantage

- More expensive to replace over time.
- Can be replaced with the wrong rated fuse.
- Not suitable for high fault current.
- Can be shorted out.

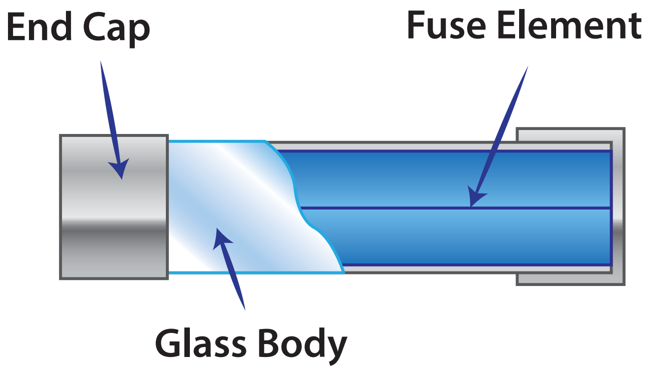

Figure C8-21: Cartridge fuse. *Source: RMS.*

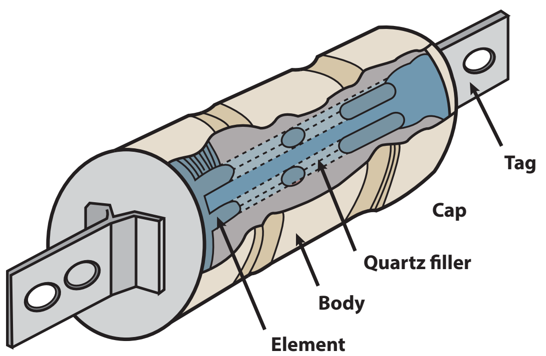

Figure C8-22: HBC fuse. *Source: RMS.*