International Diploma

ID3: Do – controlling workplace safety issues (International)

SAMPLE RESOURCES

This RMS sample resources pack contains a selection of PowerPoint slides together with a supporting lesson plan and are representative of the full set of RMS trainer materials for the NEBOSH International Diploma Unit DI3 qualification.

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Element 3
Fire and explosion

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Learning outcome

- You will be able to advise the organisation on a range of common workplace safety issues/hazards including how these can be assessed and controlled.

Assessment criteria

On completion of this element, learners should be able to describe the mechanisms for fire and explosions, how building materials behave in a fire and methods that can be used for prevention and protection from fire and explosion, in particular:

3.1 Describe the properties of flammable and explosive materials and the mechanisms by which they ignite.

3.2 Outline the behaviour of structural materials, buildings and building contents in a fire.

3.3 Describe the main methods of fire and explosion prevention and protection.

Contents

Contents

Properties of flammable and explosive materials and the mechanisms by which they ignite

- Properties of solids, liquids and gases
- Meanings of terms related to fire and explosion
- Mechanisms of fire/explosion and fire-spread
- Causes and effects of vapour cloud and boiling liquid expanding vapour explosions
- Effects of atomisation/particle size and oxygen content on the likelihood and severity of a fire/explosion
- How the physicochemical properties of materials and failure of control measures can lead to an explosion

Properties of flammable and explosive materials and the mechanisms by which they ignite

- Process of oxidisation and the effects of oxidising substances on fire and explosion mechanisms
- Flammable atmospheres
- Principles of selection of electrical equipment for use in flammable/explosive atmospheres
- Prevention and mitigation of vapour phase explosions
- Control of amount of material, prevention of release, control of ignition sources and sensing of vapour
- Dust explosions

Properties of solids, liquids and gases

- When assessing the potential for any fire or explosion, one of the most important factors to consider is the fuel type.
- In general, a combustible solid material is considered to be a lower hazard than a flammable liquid, vapour or gas.
- A flammable liquid has to vaporise before its flammable vapour can burn.
- The ease with which this happens will be affected by the type of flammable liquid itself, factors such as the speed at which the liquid vaporises (vapour pressure) and if the liquid is under pressure whilst in use.
- Any flammable gas is an obvious hazard as the molecules of gas are small enough to readily combust, sometimes explosively, but the danger it presents will be affected by factors such as the gas' 'flammable or explosive range'.

Meanings of terms related to fire and explosion

- Flash point
- Fire point
- Auto-ignition temperature
- Vapour density
- Relative density
- Limits of flammability

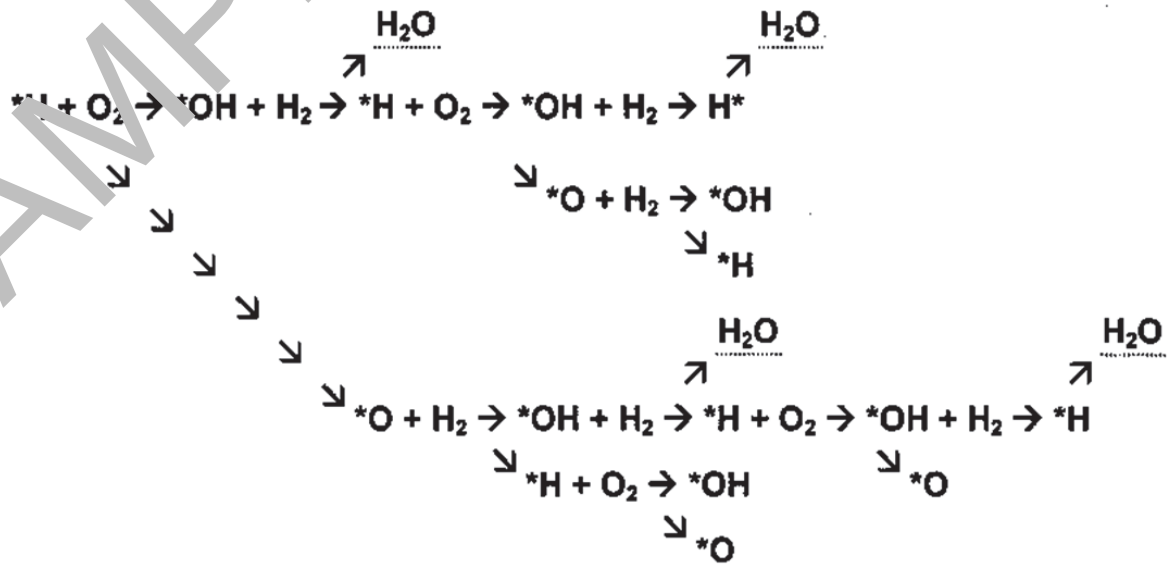
Mechanisms of fire/explosion and fire-spread

- How a fire/explosion occurs – combustion
- The stages of combustion
- Explosion

Mechanisms of fire/explosion and fire-spread

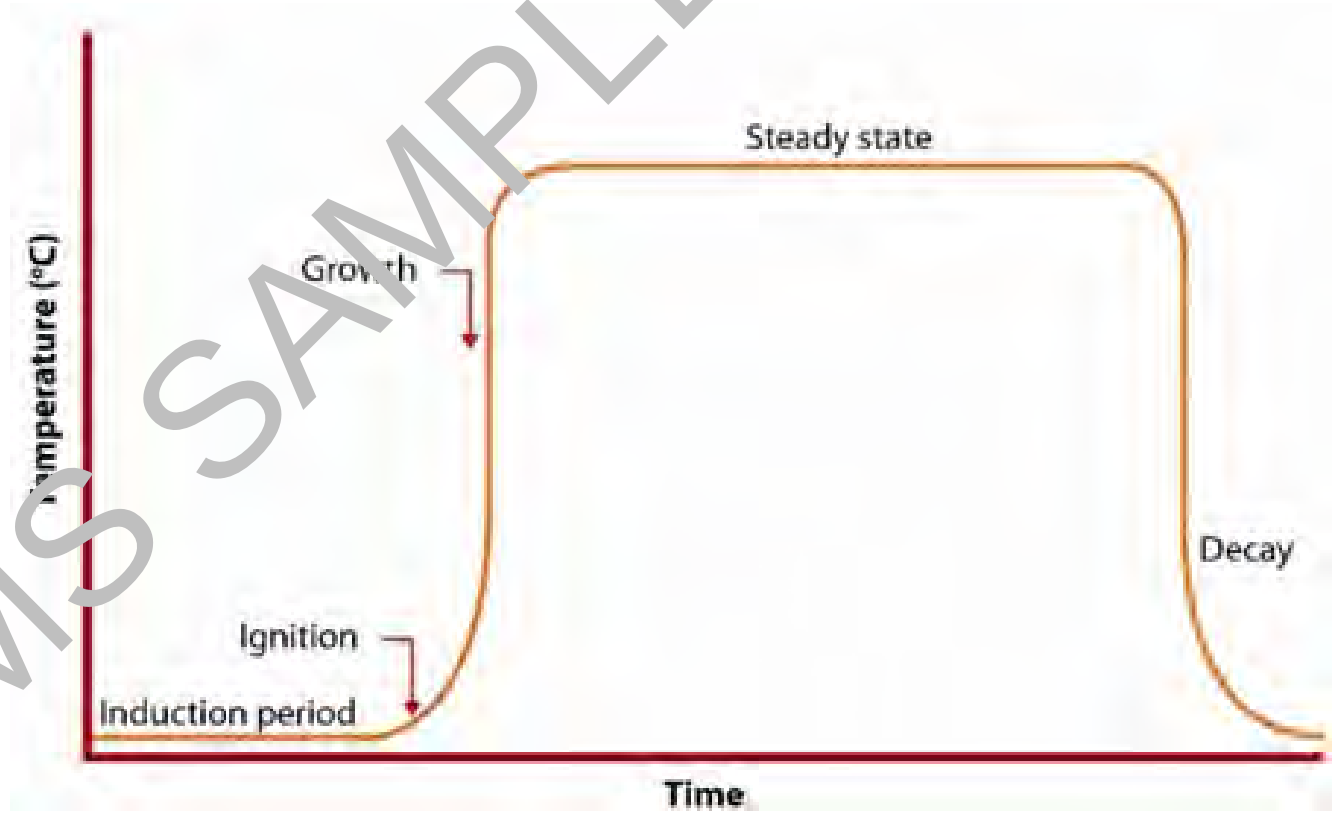
How a fire/explosion occurs - combustion

- Definition - a chemical reaction during which heat energy and light energy are emitted.
- Combustion process



The stages of combustion

- Induction
- Ignition
- Growth
- Steady state
- Decay



Mechanisms of fire/explosion and fire-spread

Explosion

- Definition - a combustion process where there is rapid flame propagation throughout an area containing flammable gases, vapours or dusts' which gives rise to pressure waves.
- Mechanisms of explosions – deflagration and detonation.

Causes and effects of vapour cloud and boiling liquid expanding vapour explosions

- Unconfined vapour cloud explosions
- Boiling liquid expanding vapour explosions
- Confined vapour cloud explosions

Unconfined vapour cloud explosions

- The term unconfined vapour cloud explosion (UCVCE) describes an explosion of flammable vapour-air mixture either in the open air or in partially confined circumstances due to the presence of partial obstructions, such as buildings, structures and trees.
- Caused when a volume of flammable vapour is released, usually accidentally, into the open air over a period of time and in sufficient quantity for a significant sized cloud of vapour-air mixture to be created that is within the flammable/explosive range for the substance released.

Unconfined vapour cloud explosions

Some of the causes of the release of flammable vapours to the open air include:

- Loss of process containment from failure of a pipe, process vessel or storage tank.
- This might be due to such things as errors in maintenance procedures or failure of materials.
- Release of vapour due to the overfilling of a storage vessel or the operation of a pressure relief system.

Unconfined vapour cloud explosions

Buncefield, 2005

- The unconfined vapour cloud explosion incident at Buncefield was one of the most significant health, safety and environmental incidents of this type to take place in the UK in recent times.

Unconfined vapour cloud explosions

Buncefield, 2005

- Early hours of Sunday 11th Dec 2005.
- Over 40 people injured.
- No fatalities.
- Damage to both commercial and residential properties.
- Fire burned for several days.

Buncefield: Tank 912 indicated

Unconfined vapour cloud explosions

Buncefield, 2005

Loss of sealant between penetrating pipe and bund wall.

Catastrophic bund wall failure at pipe penetrations

Unconfined vapour cloud explosions

Buncefield, 2005

- Illustrates the over-pressures caused by the explosions, the shaded area in the middle of the site shows where the pressure is estimated to have been higher than 100 kPa (1,000 mbar).

Overpressure effects of explosion.

NEBOSH International Diploma – DI3 – Do – controlling workplace safety issues

Lesson Plan - Day 1

TIME	ELEMENT/TOPIC	CONTENT	RESOURCE/TASK
08.45	Welcome		Computer with DVD/Sound functionality. Flip charts, examiners reports, internet access.
9.00	Introduction	Name, job, background, experience The lesson plan has been designed to be flexible – timings are only approximations that the tutor can flex – depending on the capability of the group being tutored. The delivery sequence may not necessarily follow that of the syllabus. Activities are suggested and should be varied or adapted depending on the group experience/knowledge and available time. Reference to suitable videos, props, objects from real life used in classroom instruction and other media is made, these are suggestions only and the tutor can introduce different material as they feel appropriate.	Name cards Ice breaker. Spilt the group into teams of three or four. Team members to interview each other and find out hobbies/ likes/dislikes etc. and represent these pictorially. Team to give themselves a name and introduce their team to the wider group.
	Course plan	Admin arrangements Course content Syllabus and assessment arrangements The course will require learners to undertake some research.	Complete paperwork if necessary
	Programme for the study period	Topics to be covered	Slides, NEBOSH Syllabus guide www.nebosh.org.uk (learners downloads section) Small Group exercises: as sections of the material are covered and as time permits, divide group into small groups of 2 or 3 – set selected exam-style questions relevant to topics being discussed. Outline answers only required – collect whole group feedback using flipchart as focus.
		Learning outcome 10 You will be able to advise the organisation on a range of common workplace safety issues/hazards including how these can be assessed and controlled.	
09.15	**10.1 - Safe working**	**Assessment criteria:** Outline the practical considerations for maintaining a	Slides/Flipchart

TIME	ELEMENT/TOPIC	CONTENT	RESOURCE/TASK
	environment	safe working environment. • Practical considerations in providing and maintaining safe places of work and safe means of access and egress; using safety signs ie, type of safety signs and the typical areas where they would be used. • The impact of lighting levels on safety issues: incorrect perception; failure to see clearly; stroboscopic effects; colour assessment; effect on attitudes; effects on health (including visual fatigue)	Tutor asking questions to whole group and/or specific individuals to establish learning. Tutor references: ILO Encyclopaedia of Occupational Health and Safety, Part V, https://www.iloencyclopaedia.org/preface-69563 ILO Hygiene (Commerce and Offices), ILO Convention, 1964 (No. 120) - C120, https://www.ilo.org/dyn/normlex/en/f?p=NORMLEXPUB:12100:0::NO::P12100_ILO_CODE:C120 ILO Hygiene (Commerce and Offices), Recommendation, 1964 (No. 120), https://www.ilo.org/dyn/normlex/en/f?p=NORMLEXPUB:12100:0::NO:12100:P12100_INSTRUMENT_ID:312458:NO Lighting at Work, HSG38, HSE Books, ISBN: 978-0-7176-1232-1, https://www.hse.gov.uk/pubns/priced/hsg38.pdf The health and safety toolbox, How to control risks at work, HSG268, HSE Books, ISBN: 978-0-7176-6587-7, http://www.hse.gov.uk/pubns/books/hsg268.htm
10.45	**Break**		
11.00	**10.1 – Safe working environment (cont'd)**	• Why different work areas will need different light conditions.	
11.30	**10.2 – Confined spaces**	**Assessment criteria:** Recognise risks and design safe working practices in confined spaces. • The meaning of confined spaces • Examples of where confined space entry may occur in the workplace e.g., pits in garages, trunking ducts, watercourses, trenches, tanks, silos, sewers	Slides Tutor asking questions to whole group and/or specific individuals to establish learning. Information on confined spaces is available from the HSE guidance at: http://www.hse.gov.uk/confinedspace/
12.30	**Lunch**		

TIME	ELEMENT/TOPIC	CONTENT	RESOURCE/TASK
13.00	**10.2 – Confined spaces (cont'd)**	• The factors to be considered when assessing risk: access arrangements; likely atmospheres to be encountered (including oxygen enriched, oxygen depleted, toxic and flammable); the task, materials and equipment; people at risk; reliability of safeguards (including personal protective equipment) • The factors to be considered in designing safe working practices: operating procedures and emergency policy/procedures; and training for work in confined spaces.	Confined spaces - A brief guide to working safely, INDG258, HSE, https://www.hse.gov.uk/pubns/indg258.pdf Guidance on permit-to-work systems - A guide for the petroleum, chemical and allied industries, HSG250, HSE, https://www.hse.gov.uk/pubns/priced/hsg250.pdf Safe work in confined spaces, Approved Code of Practice and guidance, L101, HSE Books, ISBN: 978-0-7176-6622-5, http://www.hse.gov.uk/pubns/books/l101.htm The health and safety toolbox, How to control risks at work, HSG268, HSE Books, ISBN: 978-0-7176-6587-7, http://www.hse.gov.uk/pubns/books/hsg268.htm
14.00	**10.3 – Fire and explosion**	**Assessment criteria:** Describe the mechanisms for fire and explosions, how building materials behave in a fire and methods that can be used for prevention and protection from fire and explosion. • The relevant properties of solids, liquids and gases with respect to influence on combustion • The meaning of: flash point, fire point, auto-ignition temperature, vapour density, limits of flammability; with examples of the importance of these properties in relation to the initiation and propagation of fire and explosion.	Slides Tutor asking questions to whole group and/or specific individuals to establish learning. Tutor references: ATEX - Directive 2014/34/EU, https://eur-lex.europa.eu/legalcontent/EN/TXT/?uri=CELEX:32014L0034 Chemical warehousing - The storage of packaged dangerous substances, HSG71, HSE, ISBN 978-0-7176-6237-1, https://www.hse.gov.uk/pubns/priced/hsg71.pdf Controlling fire and explosion risks in the workplace, INDG370, HSE, http://www.hse.gov.uk/pubns/indg370.pdf ILO Encyclopaedia of Occupational Health and