#### National Fire Certificate 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 National Fire Certificate qualification.

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## Element 2 Principles of fire and explosion



#### Contents

- 2.1 The principles of combustion, fire growth and fire spread
- 2.2 The ignition of solids, liquids and gases
- 2.3 Explosion and explosive combustion



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## The principles of combustion, fire growth and fire spread

- The fire triangle
- Combustion
- Methods of heat transfer and how they contribute to five and smoke spread through buildings and to neighbouring properties
- The stages of fire
- Factors that influence fire-g owth rates and smoke movement
- The conditions required to: mechanisms of, and impacts of flashover and backdraft



## The fire triangle





#### Combustion

- Defined as a chemical reaction during which heat energy and light therefy are emitted
- If the three components come together in the right troportions, then the chemical reaction of combustion takes place
- Once a fire has started, a self-sustaining chain reaction begins at the surface of the fuel (solid or liquid), which turns into a vapour, and it is this that burns in the combustion process



### Combustion

- Chemical reactivity
  - Endothermic
  - Exothermic
  - The conditions for the maintenance of combus ion
  - Combustion products in relation to combustion reaction conditions
  - Exothermic reaction releasing heat energy
  - Oxidising agents/materials



## Methods of heat transfer and how they contribute to fire and smoke spread

- Conduction
- Convection
- Radiation
- Direct burning



### Conduction

- Described as 'heat transfer through solid objects'
- It may occur in solids, liquids or gases
- Most clearly present in solids
- Examples of the effect are when a teaspoon in hot tea transfers heat to the hand of the person hold ig it
- Most metals are goon concurrence, with silver and copper peiring the best
- Glass, wood, co.k and asbestos are poor conductors





### Convection

- Described as 'hot gases rising', although it does occur in liquids and gases
- When a liquid or gas is heated, it expands and therefore becomes less dense
- The lighter liquid or gas rises, being displaced by colder and therefore denser liquid or gas
- The cooler liquid or gas in tur, becomes heated and so a circulation is set up
- Convection is used in connection hot water systems and in heating cystems using so-called 'radiators'
- Convection also causes the updraught in chimneys





#### Radiation

- Heat energy may also be transmitted in straight lines by a means which is neither conduction nor convection, for example, the process by which heat from the sun passes through empty space to warm the earth.
- This method of heat transmission is narical 'radiation' and does not involve any contact between bodies and is independent of any material in the intervening space
- Many fires are caused by radiation
- ne of the most corrigion is clothing being ignited whilst being dried near to a gas fire used to heat a room





## Direct burning

- One of the main methods of fire spread is by physical flame contact
- As a material burns, it has the potential for the flames from the combustion process to touch and ignite other combustible materials nearby

**Direct Burning** 



### The stages of fire

- Fire tends to grow in stages
- For example, heat may be present and exposed to a source of fuel, but not sufficiently long enough to raise the temperature of the fuel to a high level for ignition to take place
- Once ignition is reached, combustion grows very quickly and is highly cobended on the level of oxygen in the meant the final
- It then reaches a steady state where heat available and the ruel, 'oxygen used are balanced
- Once the fuel is consumed, the fire decays

![](_page_13_Figure_7.jpeg)

![](_page_13_Figure_8.jpeg)

![](_page_14_Picture_0.jpeg)

### The stages of fire

- Induction
- Ignition
- Growth
- Steady state
- Decay

![](_page_14_Figure_7.jpeg)

![](_page_15_Picture_0.jpeg)

#### The stages of fire

![](_page_15_Figure_2.jpeg)

![](_page_16_Picture_0.jpeg)

## Factors that influence fire-growth rates and smoke movement

- Fire-growth rates
- Smoke movement
- Building design (such as cavities, ducts, shafts)
- Insulated core panels / cladding
- Construction materials
- Internal linings
- Ventilation lev els
- Contents of the premises

![](_page_16_Figure_10.jpeg)

![](_page_17_Picture_0.jpeg)

### Construction materials

General considerations

- Timber factors affecting fire-resistance
- Bricks factors affecting fire-resistance
- Concrete factors affecting fire-resistance
- Metals factors affecting fire-resistance
- Building boards and slab factors affecting fire-resistance
- Plastics factors affecting thre constance
- Glazing mater also factors affecting fire-resistance

![](_page_18_Picture_0.jpeg)

#### Construction materials

![](_page_18_Figure_2.jpeg)

# The conditions required for, mechanisms of, and impacts of flashover and backdraft

- Flashover
- Backdraft

![](_page_19_Picture_3.jpeg)

#### NEBOSH National Certificate in Fire Safety – Unit FSC1 Fire safety and risk management

#### Lesson Plan - Day 1

TIME	ELEMENT/TOPIC	CONTENT	RESOURCE/TASK
08.45	Welcome		
	Introduction	Name, job, background, experience	Note cards Ice bat Spilt to group into teams of three of our Town members to interview of other and find out hob' 3/ likes/dislikes etc and opresent these pictorially. Team to give themselves a name and introduce their team to the wider group.
	Course plan	Admin arrangements Course content Syllabus and exam arrangements Progression onto other qualification	Complete paperwork if necessary
	Programme for the day	Topics to be covered	Slides
09.00	Element 1: Managing fire safety	<ul> <li>Learning utcolles:</li> <li>Ilearner will be all to justify fire safety improvements using moral and financial rg ments</li> <li>essmelt citoria:</li> <li>- Doruss the moral and financial advantages of good fire safety management in the rkplace</li> <li>1.2 - Summarise how fire safety is regulated and the roles of national government and international bodies</li> </ul>	Slides / Flipchart Introduction to element
	1.1 Moral and financial reasons for managing fire safety	Moral expectations of good standards of fire safety	Slides Activity
		The financial cost of incidents (insured and uninsured costs), including penalties that could be	Discuss the reasons for

#### NEBOSH National Certificate in Fire Safety – Unit FSC1 Fire safety and risk management

		imposed in the event of a false alarm	preventing fire and managing fire
			safety
	1.2 The role of national governments and international bodies in developing frameworks for the regulation of fire safety	Employer's responsibilities	
		Worker's responsibilities	
10.45		Break	
11.00		The role of enforcement agencies and other external agencies including course rence for non- compliance	
11.30	Element 2: Principles of fire and explosion	<ul> <li>Learning outcomes:</li> <li>Advise how fires and explosions can occur at 1 the poroprise controls to minimise fire and explosion risks</li> <li>Assessment criteria:</li> <li>2.1 - 2.3 - Provibe the principles of compustion in relation to fire safety</li> </ul>	
	2.1 The principles of combustion, fire growth and fire spread	The fire angle	
	R	<ul> <li>&gt;mL +ic :</li> <li>Cuemical reactivity The conditions for the maintenance of combustion</li> <li>Examples of combustion products in relation to combustion conditions (complete and incomplete reaction)</li> <li>Exothermic reaction releasing heat energy</li> <li>Oxidising agents/materials</li> </ul>	
		Methods of heat transfer; conduction, convection, radiation, and direct burning and how they contribute to fire and smoke spread through buildings and to neighbouring properties	

#### NEBOSH National Certificate in Fire Safety – Unit FSC1 Fire safety and risk management

		The stages of a fire:
		Induction
		• Ignition
		Fire growth
		Steady state
		• Decay
12.30		Lunch
13.30		Factors that influence fire growth rates and smoke movement
	2.2 – The ignition of	Building design (such as cavities, ducts, shafts)  Insulated core panels Construction materials Internal linings Ventilation levels Contents of the premises The conditions required for, mechanisms of, and imports or high very and backdraft Meaning and relevance of flash point on report and ig it or point "kingling point); auto ignition temperatures wareau destitue wareau pressures flammable limit.
	solids, liquids and gases	temperature; vapour density; vapo pressure flamme le liquid categories: upper flammable limit; lower flammable limit
		The conditions required a cause the ignition of renbustible solids, flammable liquids and gaseous materials
15.00		Break
15.15	2.3 – Explosion and explosive combustion	Common na rials volver , explosions (flammable vapours, gases, dusts)
	R	<ul> <li>e co. litons required for, mechanisms of, and impacts of the following type of explosion:</li> <li>Unconfined Vapour Cloud Explosion</li> <li>Confined Vapour Cloud Explosion</li> <li>Boiling Liquid Expanding Vapour Explosion (BLEVE)</li> <li>Dust (Primary and secondary explosions)</li> </ul>
17.00	End of day 1	Set overnight work