

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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NEBOSH

Certificate in Fire Safety

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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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Contents

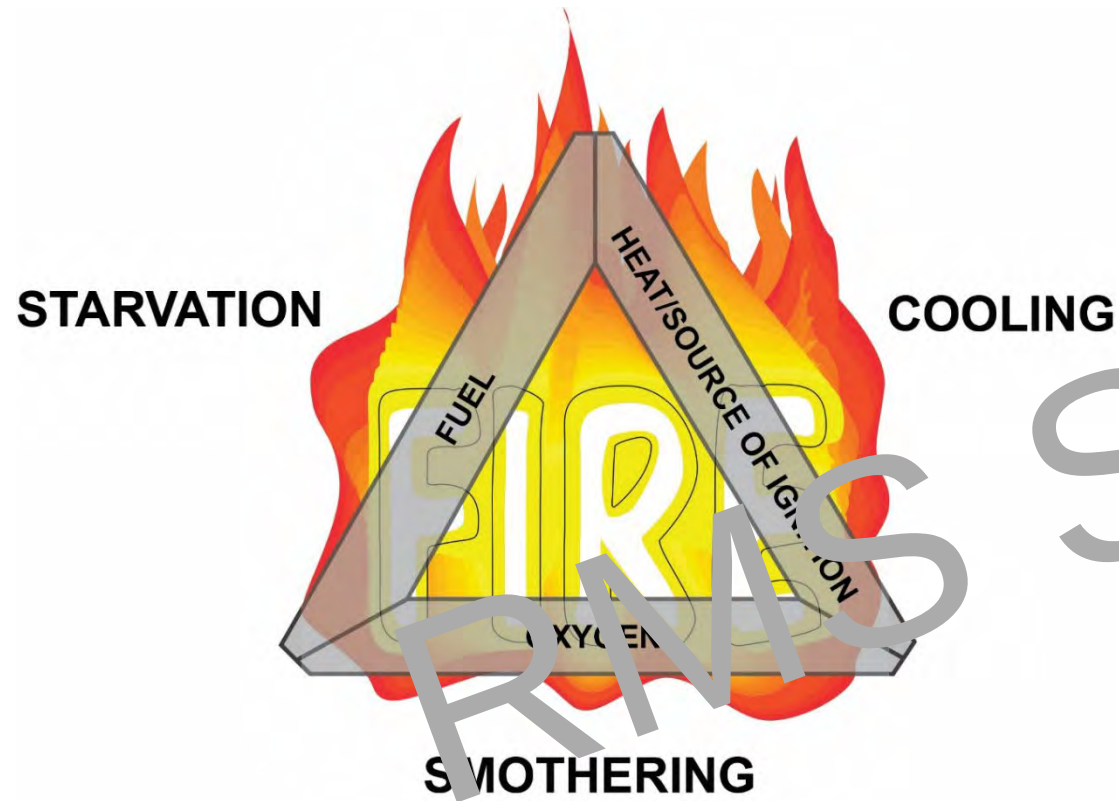
- 2.1 The principles of combustion, fire growth and fire spread
- 2.2 The ignition of solids, liquids and gases
- 2.3 Explosion and explosive combustion

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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 fire and smoke spread through buildings and to neighbouring properties
- The stages of fire
- Factors that influence fire growth rates and smoke movement
- Fire under free burning conditions and in enclosed conditions
- The conditions required for, mechanisms of, and impacts of flashover and backdraft

The fire triangle



Three essential components:

- Fuel
- Oxygen
- Ignition source (heat)

Combustion

- Defined as a chemical reaction during which heat energy and light energy are emitted
- If the three components come together in the right proportions, 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

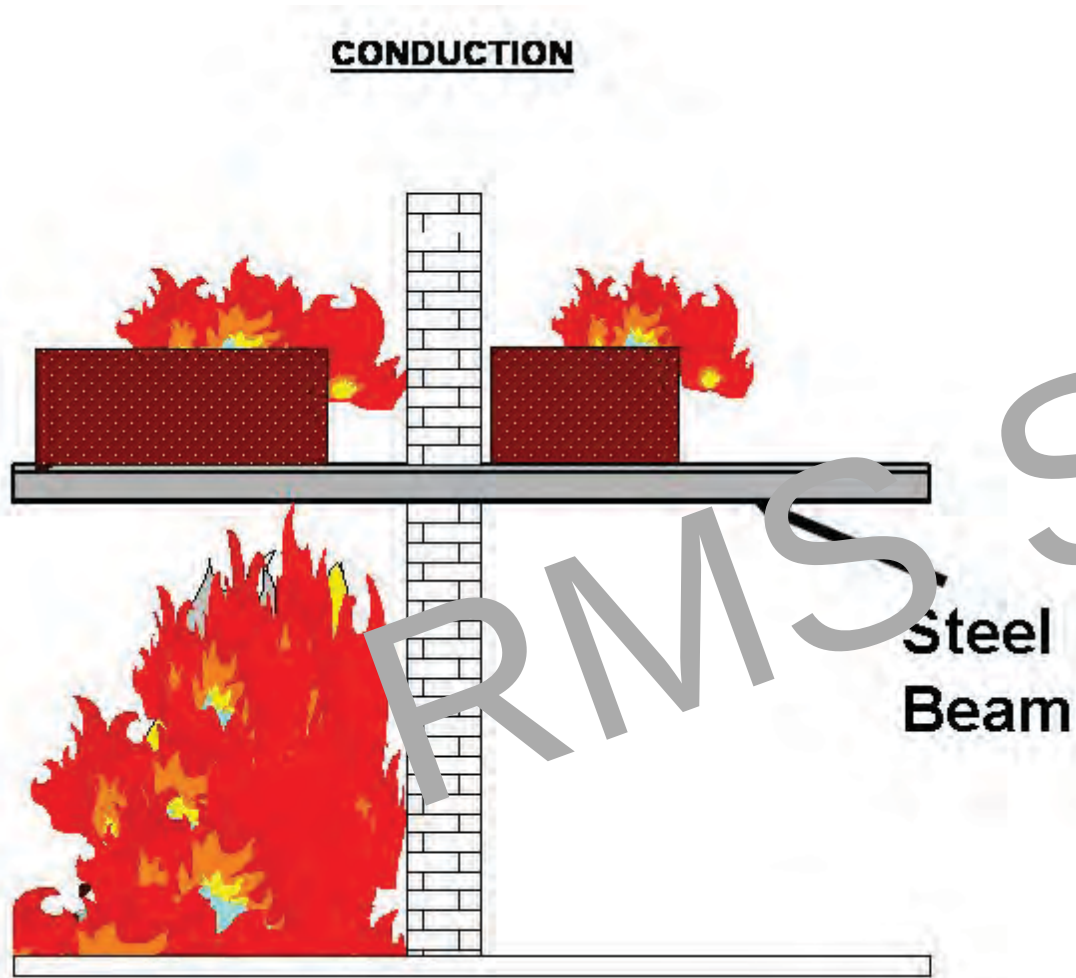
- Chemical reactivity
 - Endothermic
 - Exothermic
- The conditions for the maintenance of combustion
- Combustion products in relation to combustion reaction conditions
- Exothermic reaction releasing heat energy
- Oxidising agents/materials

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

- Conduction
- Convection
- Radiation
- Direct burning

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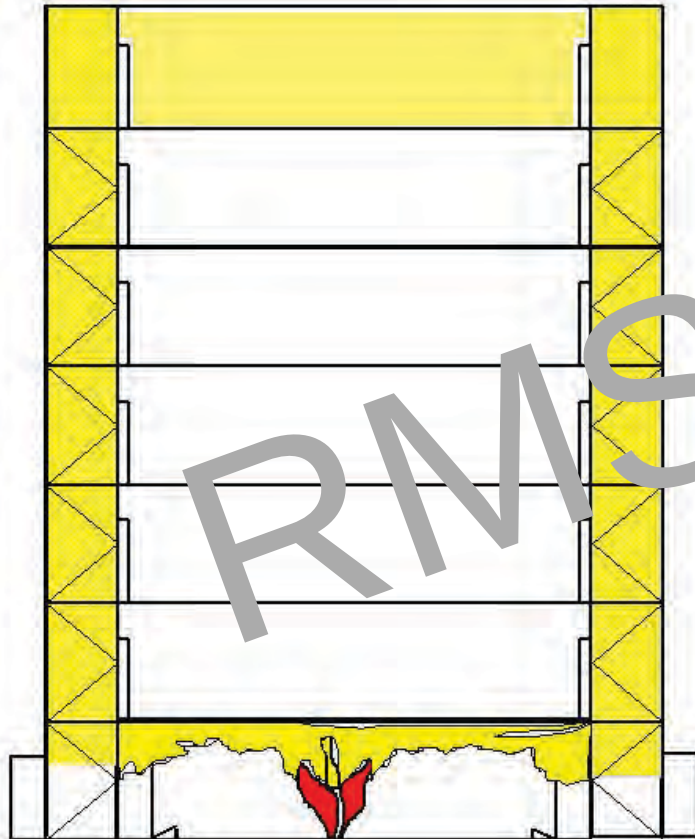
Conduction



- 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 holding it
- Most metals are good conductors, with silver and copper being the best
- Glass, wood, cork and asbestos are poor conductors

Convection

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 turn becomes heated and so a circulation is set up
- Convection is used in domestic hot water systems and in heating systems using so-called 'radiators'
- Convection also causes the updraught in chimneys

Radiation



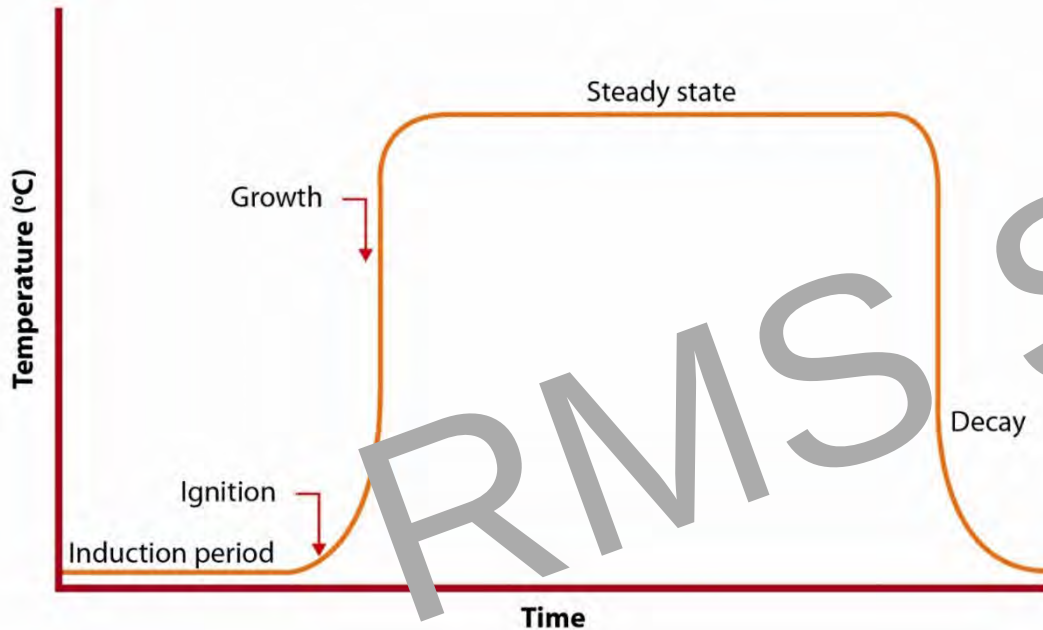
- Heat energy may also be transmitted in straight lines by a means which is neither conduction nor convection, for example, the process by which heat from the sun passes through empty space to warm the earth.
- This method of heat transmission is named 'radiation' and does not involve any contact between bodies and is independent of any material in the intervening space
- Many fires are caused by radiation
- One of the most common 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

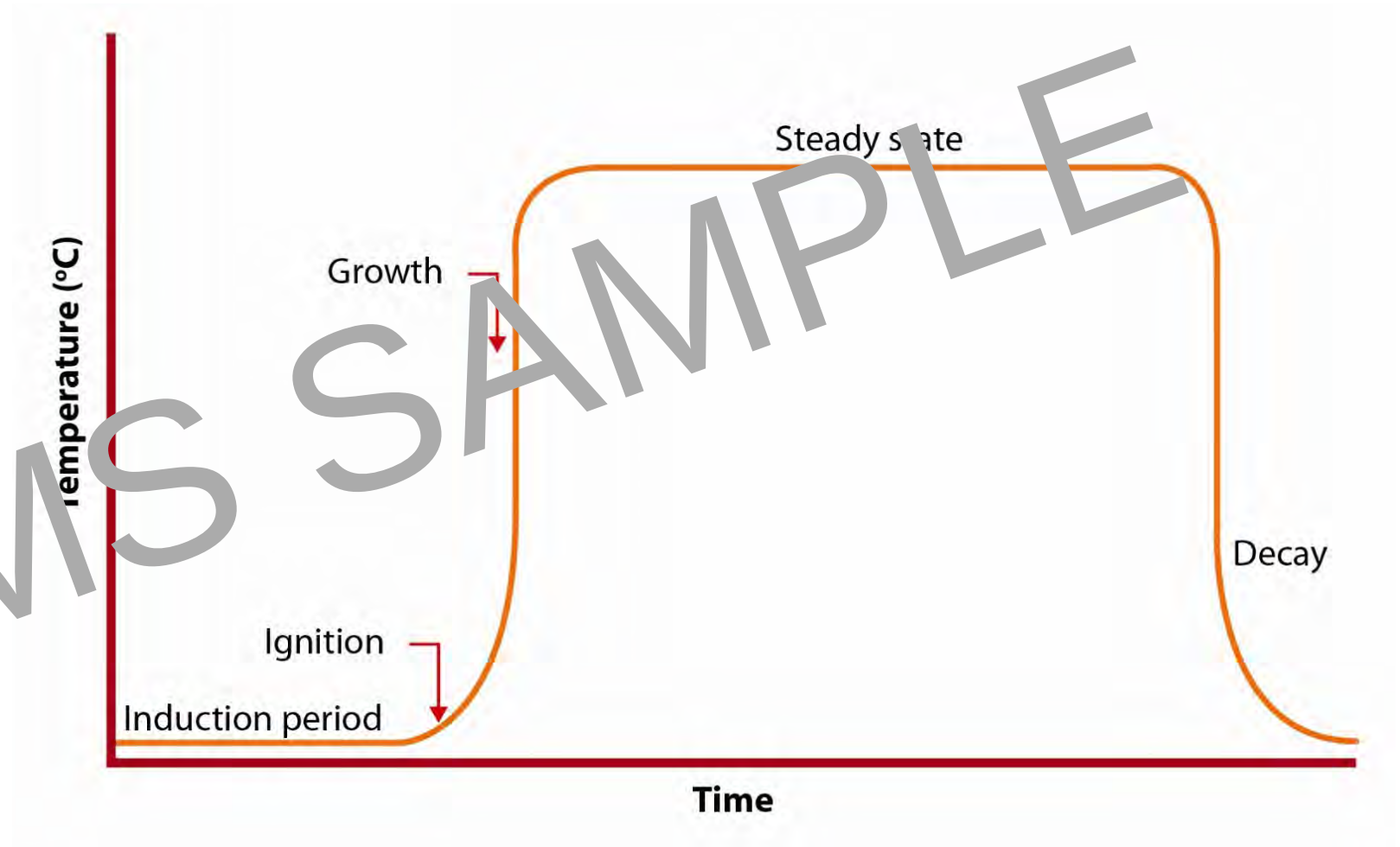
The stages of fire



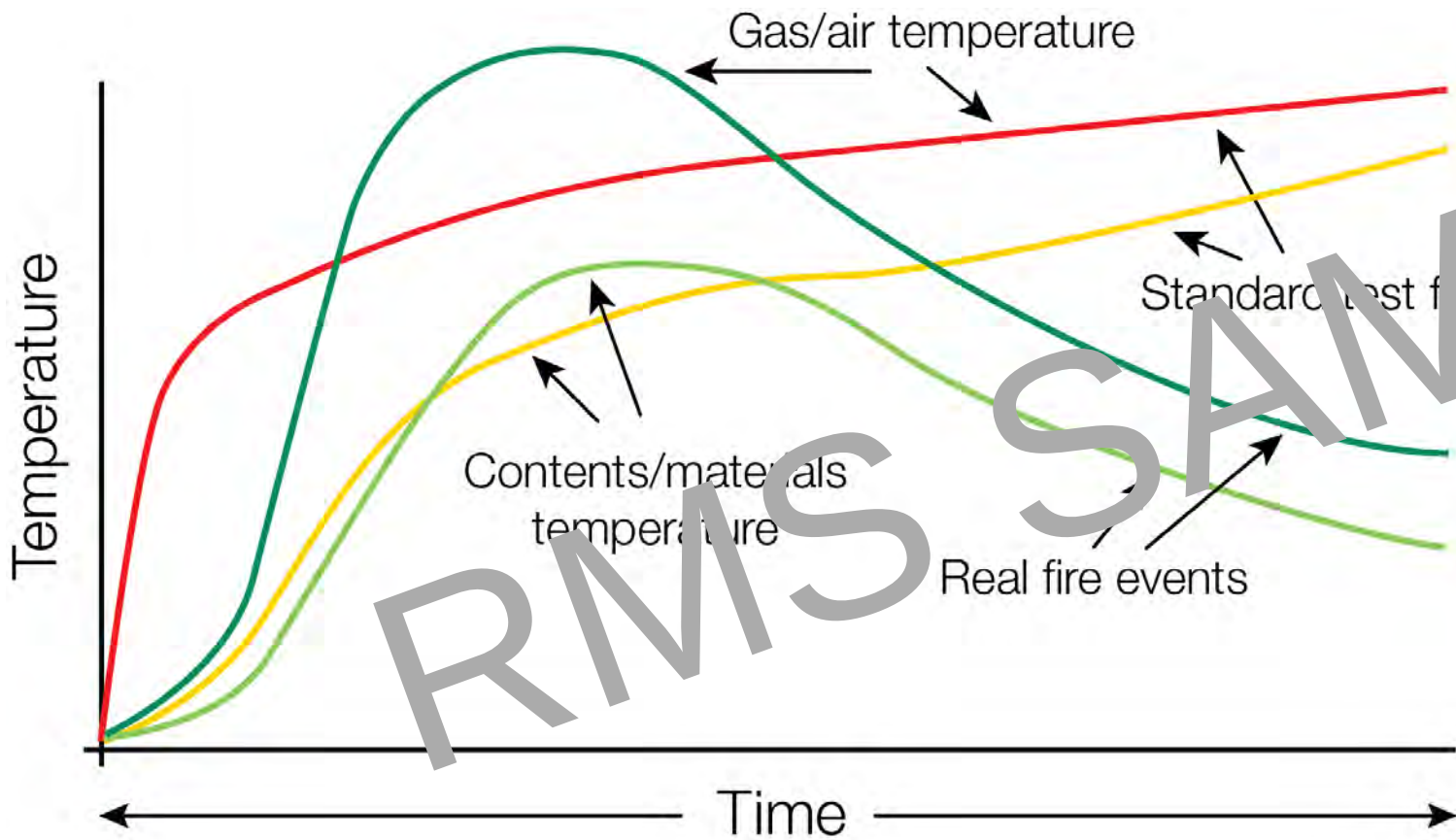
- Fire tends to grow in stages
- For example, heat may be present and exposed to a source of fuel, but not sufficiently long enough to raise the temperature of the fuel to a high level for ignition to take place
- Once ignition is reached, combustion grows very quickly and is highly dependent on the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

The stages of fire

- Induction
- Ignition
- Growth
- Steady state
- Decay

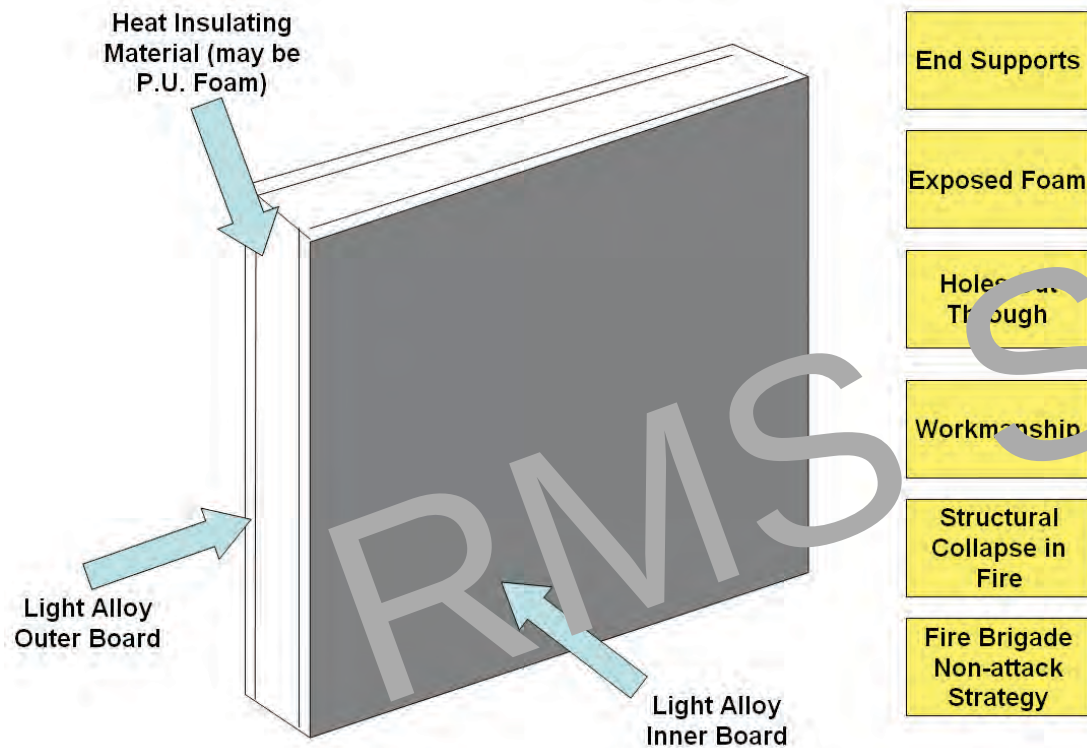


The stages of fire



- Fire-growth curve for 'standard' and real fires

Factors that influence fire-growth rates and smoke movement



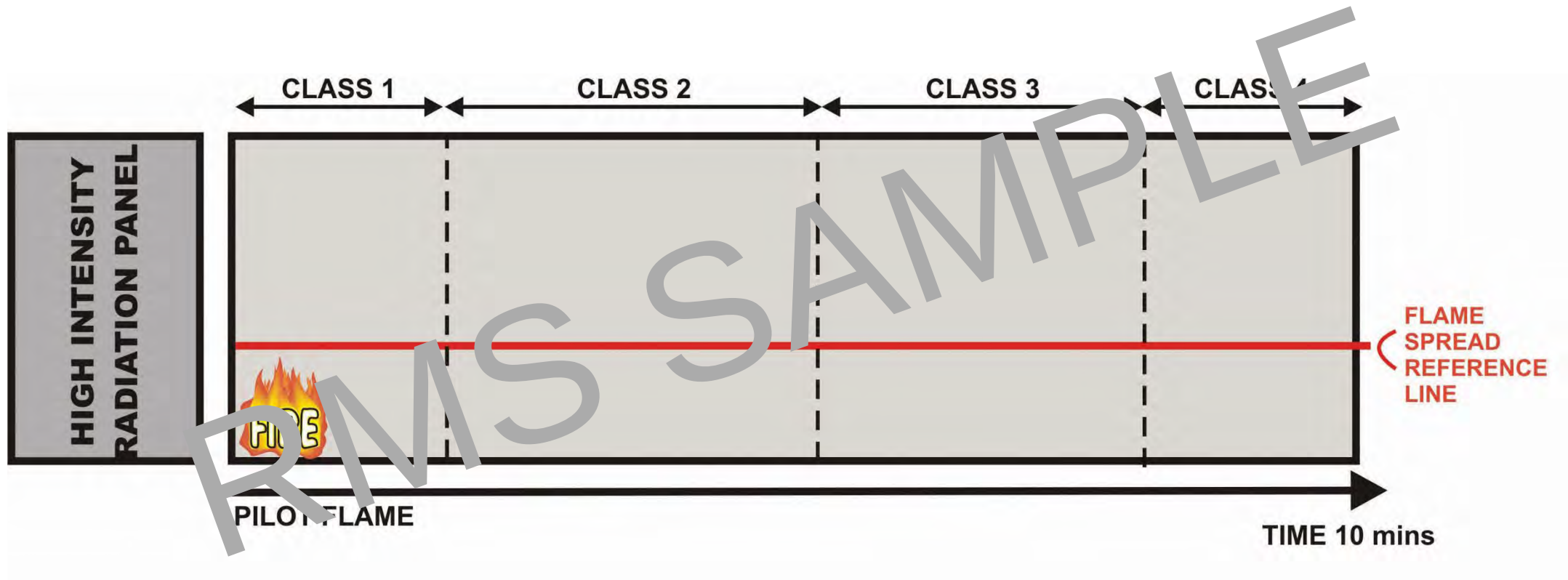
- Fire-growth rates
- Smoke movement
- Building design (such as cavities, ducts, shafts)
- Insulated core panels / cladding
- Construction materials
- Internal linings
- Ventilation levels
- Contents of the premises

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 slabs – factors affecting fire-resistance
- Plastics – factors affecting fire-resistance
- Glazing materials – factors affecting fire-resistance

Construction materials

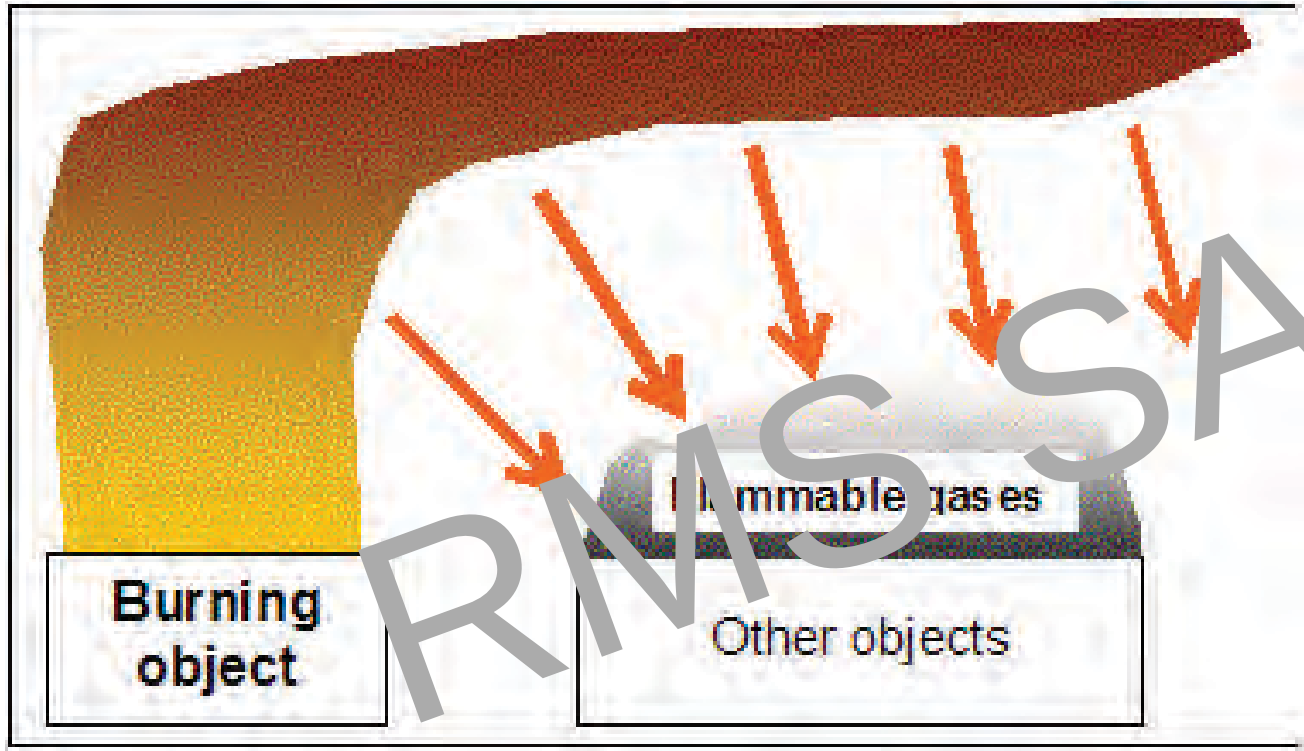


Horizontal spread time chart

Fire under free burning conditions and in enclosed conditions

- Speed of fire-growth is generally much slower for an open burning fire as opposed to a fire in an enclosed space
- Any fire in enclosed conditions will usually **free burn** until oxygen levels in the immediate fire area become reduced to the point where total combustion cannot take place
- The rate of ventilation to the fire area will then control the efficiency of the burn rate of the materials involved
- If ventilation levels are good the materials involved will continue to free burn and a **flashover** situation may occur
- If the ventilation levels are limited, the fire does not burn efficiently and large volumes of hot smoke can be given off - can lead to a **backdraught** situation

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



- Flashover
- Backdraft

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Element 2 Principles of fire and explosion

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		Complete attendance sheet
	Introduction	Name, job, background, experience	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 exam arrangements Progress on onto other qualifications	Complete paperwork if necessary
	Programme for the day	Topics to be covered	Slides
09.00	Element 1: Managing fire safety	Learning outcomes: The learner will be able to justify fire safety improvements using moral and financial arguments Assessment criteria: 1.1 – Discuss the moral and financial advantages of good fire safety management in the workplace 1.2 - Summarise how fire safety is regulated and the roles of national government and international bodies	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 Case study: Grenfell Tower

NEBOSH National Certificate in Fire Safety (Unit FSC1 Fire safety and risk management)

TIME	ELEMENT/TOPIC	CONTENT	RESOURCE/TASK
			London fire: A visual guide to what happened at Grenfell Tower 72 people are confirmed to have died after a huge fire engulfed a west London tower block. While some residents of Grenfell Tower, a 24-storey building in North Kensington, escaped as the fire took hold on 14 June 2017, others were trapped inside. See the following link for a visual guide to what happened at Grenfell Tower www.bbc.co.uk/news/uk-40301289
		The financial cost of incidents (insured and uninsured costs), including penalties that could be imposed in the event of a false alarm	Slides Activity - Case study: Grenfell Tower London fire: A visual guide to what happened at Grenfell Tower 72 people are confirmed to have died after a huge fire engulfed a west London tower block. While some residents of Grenfell Tower, a 24-storey building in North Kensington, escaped as the fire took hold on 14 June 2017, others were trapped inside. See the following link for a visual guide to what happened at

NEBOSH National Certificate in Fire Safety (Unit FSC1 Fire safety and risk management)

TIME	ELEMENT/TOPIC	CONTENT	RESOURCE/TASK
			Grenfell Tower www.bbc.co.uk/news/uk-40301289 Consider what are the moral, legal and financial considerations of inadequate management of fire safety standards at Grenfell Tower?
	1.2 The role of national governments and international bodies in developing frameworks for the regulation of fire safety	Employer's responsibilities	Refer to Control of Regulatory Reform (fire safety) Regulations Order Explain the Regulatory Reform (Fire Safety) Order and how it interacts with other legislation
		Worker's responsibilities	Slides
10.45		Break	
11.00		The role of enforcement agencies and other external agencies including consequences for non-compliance	Slides
11.30	Element 2: Principles of fire and explosion	Learning outcomes: Assess how fires and explosions can occur and the appropriate controls to minimise fire and explosion risks Assessment criteria: 2.1 – 2.3 – Describe the principles of combustion in relation to fire safety	Slides / Flipchart Introduction to element
	2.1 The principles of combustion, fire growth and fire spread	The fire triangle	Slides
		Combustion: Chemical reactivity	Slides

NEBOSH National Certificate in Fire Safety (Unit FSC1 Fire safety and risk management)

TIME	ELEMENT/TOPIC	CONTENT	RESOURCE/TASK
		- The conditions for the maintenance of combustion - Examples of combustion products in relation to combustion conditions (complete and incomplete reaction) - Exothermic reaction releasing heat energy Oxidising agents/materials	
		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	Slides
		The stages of a fire: - Induction - Ignition - Fire growth - Steady state - Decay	Slides
12.30		unch	
13.30		Factors that influence fire growth rates and smoke movement	
		Building design (such as cavities, ducts, shafts) - Insulated core panels - Construction materials - Internal linings - Ventilation levels Contents of the premises	Slides
		The conditions required for, mechanisms of, and impacts of flashover and backdraft	Slides
	2.2 – The ignition of solids, liquids and gases	Meaning and relevance of flash point, fire point and ignition point (kindling point); auto ignition temperature; vapour density; vapour pressure; flammable liquid categories: upper flammable limit; lower flammable limit	Slides
		The conditions required to cause the ignition of combustible solids, flammable liquids and gaseous materials	Slides Group discussion: Ask learners to think about your workplace. How

NEBOSH National Certificate in Fire Safety (Unit FSC1 Fire safety and risk management)

TIME	ELEMENT/TOPIC	CONTENT	RESOURCE/TASK
			many possible sources of ignition, fuel and oxygen can they identify?
15.00	Break		
15.15	2.3 – Explosion and explosive combustion	Common materials involved in explosions (flammable vapours, gases, dusts)	Slides
		The conditions required for, mechanisms of, and impacts of the following type of explosion: • Unconfined Vapour Cloud Explosion • Confined Vapour Cloud Explosion • Boiling Liquid Expanding Vapour Explosion (BLEVE) • Dust (Primary and secondary explosions)	Slides Optional YouTube videos: Car mechanic engulfed in fire https://www.youtube.com/watch?v=ic7F5EA6bo Description of a BLEVE https://www.youtube.com/watch?v=UM0jtD_OWLU&t=2s
17.00	Close	Check learners understanding of the learning material. Ask 'open' questions on the material covered. Issue of overnight work - Tutor Directed Study	Verbal exchange learners/tutor