

International 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 International Fire Certificate qualification.

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NEBOSH International Certificate in Fire Safety and Risk Management

Element 2

Principles of fire and explosion

Learning outcomes

- 2.1 Explain the principles of the combustion process in relation to fire safety
- 2.2 Explain the principles and conditions for the ignition of solids, liquids and gases
- 2.3 Identify the classification of fires
- 2.4 Describe the principles of fire-growth and fire spread
- 2.5 Outline the principles of explosion and explosive combustion

Contents

- 2.1 The principles of the combustion process in relation to fire safety
- 2.2 The principles and conditions for ignition
- 2.3 The classification of fires
- 2.4 The principles of fire-growth and fire spread
- 2.5 The principles of explosion and explosive combustion

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The principles of the combustion process in relation to fire safety

- The concept of the fire triangle
- Combustion
- The stages of fire

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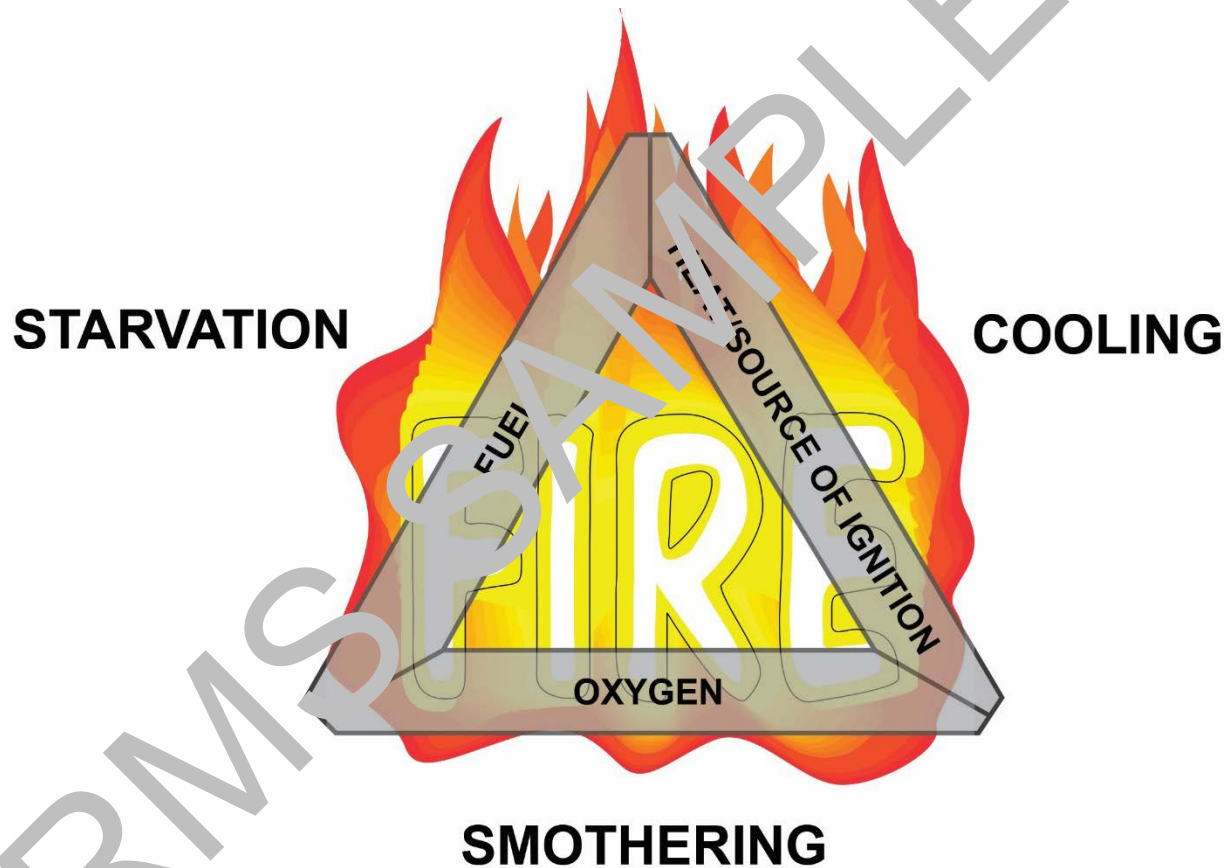
The concept of the fire triangle

Three main essential components:

- 1) Fuel
- 2) Oxygen
- 3) Ignition source (heat)
 - When brought together a fire occurs
 - Often depicted by the 'fire triangle'

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The fire triangle



Source: RMS/CorelDraw! 5.0 Clipart

Combustion

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

Combustion

The chemistry of combustion

- Defined as a chemical reaction during which heat energy and light energy are emitted
- If the three components of fuel, oxygen and ignition source come together in the right proportions then the chemical reaction of combustion takes place
- Once a fire starts a self-sustaining chain reaction begins at the surface of the fuel
- Turns into a vapour, which is what burns in the combustion process
- A similar process occurs with the molecules of a gas

Combustion

Chemical reactivity

Endothermic

- Chemical reactions that must absorb energy in order to proceed are called endothermic reactions
- Cannot occur spontaneously, work must be done in order to get these reactions to occur

Exothermic

- Many chemical reactions release energy in the form of heat, light, or sound
- These are exothermic reactions
- Combustion involves an exothermic reaction

Combustion

The conditions for the maintenance of combustion

Fuel	The fuel dictates all aspects of combustion. The type of fuel, the form the fuel is in, or how much is present in the air will influence its susceptibility to combustion.
Heat	The amount of heat that is required from the source of ignition to cause combustion of the fuel is dictated by the form (solid, liquid, vapour or gas) and type of fuel.
Oxygen	Oxygen is provided from the air around us. Other than in specialised industrial applications, it is always present. (Note: if oxygen levels drop below 15% the combustion process stops). Consideration should be given to how the available oxygen might inadvertently be increased (oxygen enrichment) via oxidising agents or oxygen cylinders. (Note: a 2% increase in oxygen levels, to 23%, is sufficient to accelerate the combustion process).

Combustion

The conditions for the maintenance of combustion

For the combustion process all three of the component parts must remain present. If one or more of these parts is removed, the fire will be extinguished:

- 1) **Cooling** the fire to remove the heat, for example, water or foam extinguisher
- 2) **Starving** the fire of fuel, for example, isolation of gas supply
- 3) **Smothering** the fire by limiting its oxygen supply, for example Carbon dioxide or foam extinguisher
- 4) **Chemical interference** of the flame reactions, for example, method by which some extinguishing media work, typically wet chemical

Combustion

Combustion products in relation to combustion reaction conditions

- Combustible materials will ignite and burn freely if the conditions for the combustion process are favourable
- If conditions are not favourable then incomplete combustion reactions will take place and larger particles of smoke will be produced
- If the conditions are favourable, then very little smoke will be produced

Combustion

Exothermic reaction releasing heat energy

- In the combustion process of a fire, the exothermic reaction releases heat energy
- Provides energy to nearby fuel – solid or liquid
- Combustion takes place
- A small fire can quickly get out of control
- Typical examples.
 - The burning or combustion of hydrocarbon fuels, for example, petrol or candle wax
 - The burning of magnesium, reaction of magnesium with acids, or the reaction of sodium with water
 - The neutralisation of acids and alkalis
 - Using hydrogen as a fuel in fuel cells

Combustion

Oxidising agents/materials

- Oxidising materials are liquids or solids that readily give off oxygen or other oxidising substances
- Also include materials that react chemically to oxidise combustible (burnable) materials
- Reaction may be spontaneous either at room temperature or under slight heating
- Oxidising liquids and solids can be severe fire and explosive hazards

Combustion

Oxidising agents/materials

Oxidising materials can:

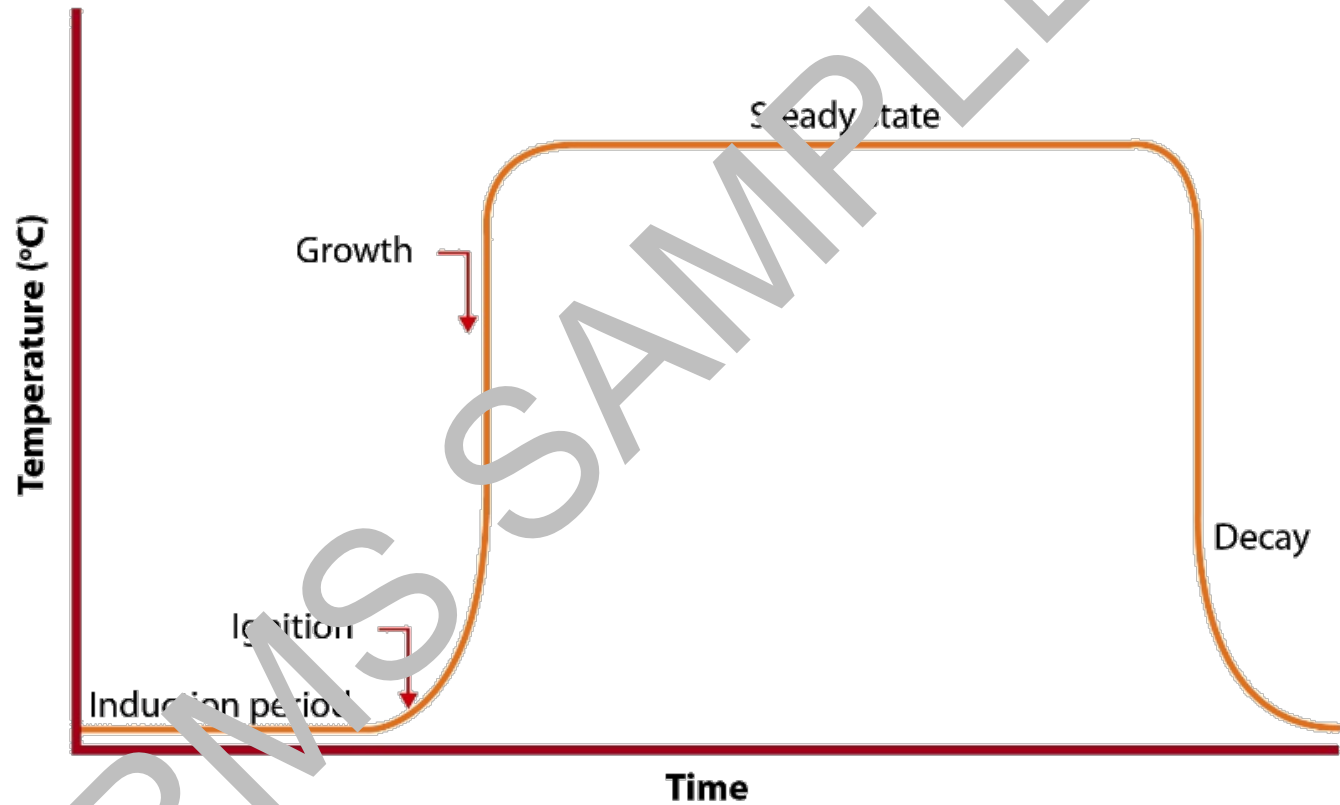
- Speed up the development of a fire and make it burn more intense
- Cause substances that do not normally burn readily in air to burn rapidly
- Cause combustible materials to burn spontaneously without the presence of an obvious ignition source such as a spark or flame

The stages of fire

- Induction
- Ignition
- Growth
- Steady state
- Decay

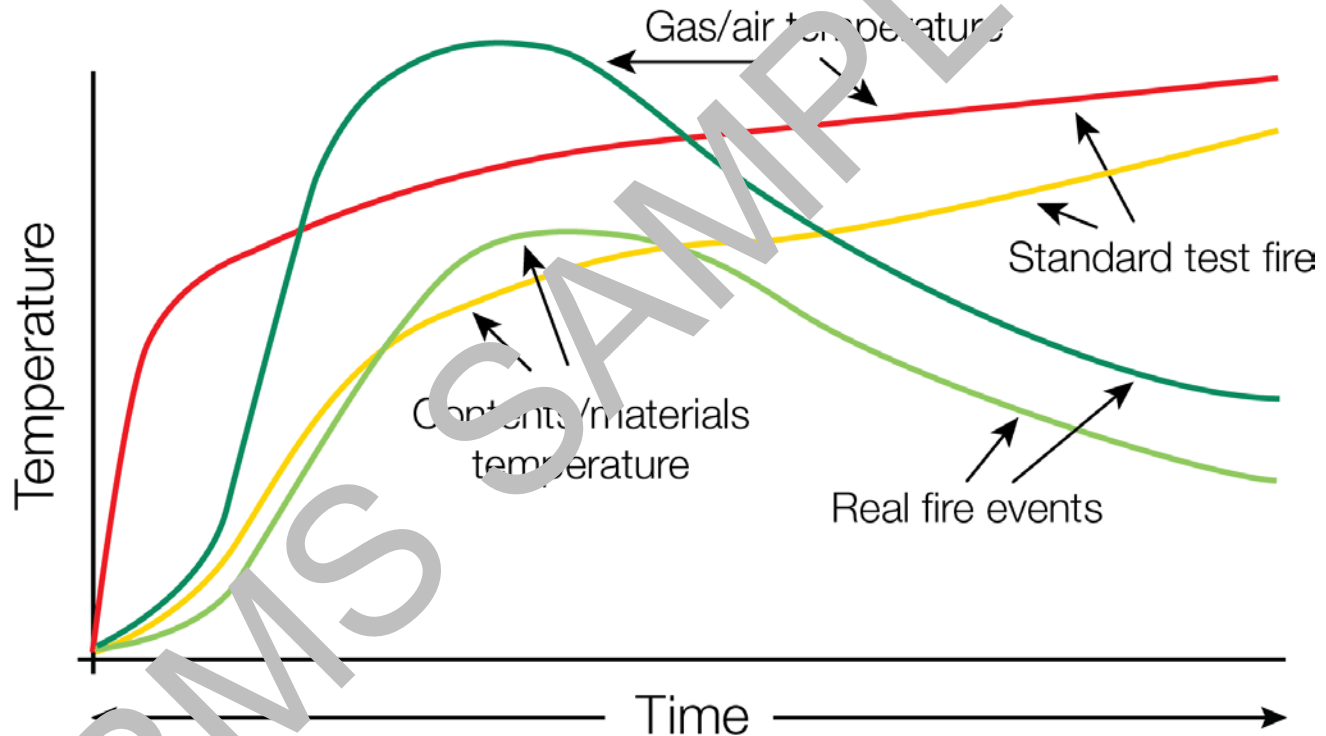
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Stages of combustion



Source: RMS

Fire-growth curve for 'standard' and real fires



Source: FSTC Ltd.

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The principles and conditions for ignition

- Meaning and relevance of terms
- The conditions for ignition to occur
- Methods of preventing or controlling ignition

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Meaning and relevance of terms

- Flash point
- Fire point
- Ignition point
- Auto ignition temperature (kindling point)
- Vapour density
- Relative density
- Vapour pressure
- Flammable
- Upper and lower flammable limits
- Combustion

Meaning and relevance of terms

Flash point

Flash point is defined as:

- The lowest temperature at which sufficient vapour is produced from a flammable liquid that momentary or flash ignition occurs when an ignition source is applied

Meaning and relevance of terms

Fire point

- The lowest temperature at which the heat produced will enable combustion to continue after a substance is ignited

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Meaning and relevance of terms

Ignition point

- Ignition temperature refers to the minimum temperature at which a substance that is flammable must be heated before it begins burning without the source of the heat being maintained

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NEBOSH International Certificate in Fire Safety and Risk Management

NEBOSH International Certificate in Fire Safety – Unit FC1 Fire safety and risk management

Lesson Plan - Day 1

TIME	ELEMENT/TOPIC	CONTENT	RESOURCE/TASK
09.00	Welcome		
	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 Progression onto other qualifications	Complete paperwork if necessary
	Programme for the day	Topics to be covered	Slides
09.30	Element 1: Managing fire safety	Learning outcomes: - Outline the moral, social and economic benefits of good management of fire safety - Outline the key features of a fire safety policy - Explain the role of national governments and international bodies in formulating a framework for the regulation of fire safety - Outline the main sources of external fire safety information and the principles of their application - Explain the purpose of, and the procedures for, investigating fires in the workplace - Explain the requirements for recording and reporting fire related incidents	Slides / Flipchart Introduction to element
	1.1 The moral, social and economic benefits of good	Financial implications of false alarms (such as possible penalties that may be imposed, business interruption, etc)	Slides Activity

NEBOSH International Certificate in Fire Safety – Unit FC1 Fire safety and risk management

	management of fire safety		
		The size of the fire safety 'problem' in terms of the numbers of fire-related fatalities and injuries and environmental damage	Discuss the reasons for preventing fire and managing fire safety
		The roles and responsibilities of the occupier of a building	
		Costs of inadequate management of fire safety including loss of business continuity	Discuss examples: Windsor Tower (Madrid), Buncefield Oil Terminal fire and explosion
10.45	Break		
11.00	1.2 The key features of a fire safety policy	Responsibility for fire safety within an organisation and the arrangements for ensuring fire safety. To include arrangements for: • planning • organisation • control • monitoring • review • arrangements for vulnerable people • degraded systems planning	
12.30	Lunch		
13.30	1.3 The role of national governments and international bodies in formulating a framework for the regulation of fire safety	Employers' responsibilities Workers' responsibilities The role of enforcement agencies and the consequences of non-compliance International standards and conventions (e.g. International Standards Organisation (ISO) and the International Labour Organisation – ILO) Source of information on National Standards	
	1.4 Main sources of external fire safety information and the	Appropriate national legislation and guidance such as the UK Department for Communities and Local Government practical fire safety guidance Fire guidance eg, British Standards Institute (BSI) for fire safety, The Confederation of Fire Protection	Discuss the information available in the way of guidance books Discuss other sources of