

# IFE Level 3 Diploma in Fire Science and Fire Safety

## Unit 7: Fire Investigation

Unit Reference Number: D/507/7414

### Introduction

This unit focuses on the understanding and technical knowledge required by those who investigate the cause of fire. It is intended for Watch and Crew Managers in the Fire and Rescue Service in charge of operational fire appliances and also for fire safety specialists.

The unit covers the scientific principles that underpin the dynamics of fire as well as the process of investigation for smaller fire scenes and provides a basis for progression to Fire Investigation specialist roles.

### Learning Outcomes

Candidates who achieve this unit should be able to:

- apply fire science principles in carrying out fire investigations at simple fire scenes and arrive at a conclusion
- explain the preparations and procedures to investigate an incident involving fire and/or explosion
- explain and apply the principles that underpin the collation and analysis of evidence
- analyse information to produce conclusions based on evidence and fire science
- prepare a more complex scene for handover to a specialist investigator

### Unit Status

Optional

### Content

#### 1. Investigating Fire Scenes

Assessment Objective	Knowledge, Understanding and Skills
1.1 Explain the reasons for investigating fires	<ul style="list-style-type: none"> <li>• Determining cause of fire</li> <li>• Risk reduction</li> <li>• Preventing reoccurrence</li> <li>• Dealing with arson</li> <li>• Reporting to the Coroner</li> </ul>
1.2 Explain the scientific method/systematic approach	<ul style="list-style-type: none"> <li>• Understand scientific methodology/ systematic approach</li> </ul>

	<ul style="list-style-type: none"> <li>• Define and explain the key stages of an investigation</li> <li>• Devising and testing a hypothesis</li> </ul>
1.3 Assess hazards and risks and determine appropriate control measures to maintain health and safety at fire scenes	<ul style="list-style-type: none"> <li>• Scene safety</li> <li>• Utilities</li> <li>• Hazardous substances</li> <li>• Fire and explosion hazards</li> <li>• Electrical hazards</li> <li>• Personal equipment</li> <li>• Hygiene</li> <li>• Evaluating the risk</li> <li>• Recording a risk assessment</li> </ul>

## 2. Fire Science

Assessment Objective	Knowledge, Understanding and Skills
2.1 Understand the chemistry of combustion	<ul style="list-style-type: none"> <li>• Combustion processes</li> <li>• Fire chemistry</li> <li>• Fire tetrahedron</li> <li>• Combustion</li> <li>• Chain reactions</li> </ul>
2.2 Understand the properties and behaviour of accelerants, fuels and oxidisers and explain their signification in relation to fire investigation	<ul style="list-style-type: none"> <li>• Types and properties of accelerants</li> <li>• Flashpoints of liquids</li> <li>• Boiling points of liquids</li> <li>• Flammability (explosive limits)</li> <li>• Stoichiometric mixtures</li> <li>• Stoichiometry of vapours and gases</li> <li>• Fuels (metals)</li> <li>• Fuels (solid fuels)</li> <li>• Supporters of combustion</li> </ul>
2.3 Understand the properties and behaviour of explosive materials and explain their importance in relation to fire investigation	<ul style="list-style-type: none"> <li>• Properties of explosives</li> <li>• (UN) Classes of explosives</li> <li>• High (detonating) and low (deflagrating) explosives</li> <li>• Propellants, ignitors and bursting charges</li> <li>• Types and uses of explosives</li> </ul>
2.4 Understand fire behaviour and apply this understanding to fire investigation	<ul style="list-style-type: none"> <li>• Fire development</li> <li>• <math>t^2</math> fire</li> <li>• Steady state fire</li> <li>• Compartment fire behaviour</li> <li>• Ventilation controlled fires</li> <li>• Fuel controlled fires</li> <li>• Estimating fire size</li> </ul>
2.5 Understand electricity and electrical causes of fire	<ul style="list-style-type: none"> <li>• Ohm's law</li> <li>• Series and parallel circuits</li> <li>• Calculations involving voltage, current, resistance and power</li> <li>• Fault current</li> <li>• Earth fault loop impedance</li> </ul>

### 3. Scene Examination

Assessment Objective	Knowledge, Understanding and Skills
3.1 Describe the role of witnesses and understand the information that they can provide	<ul style="list-style-type: none"> <li>• Owners and occupiers</li> <li>• Fire service witnesses</li> <li>• Other members of the public</li> <li>• Interviewing witnesses</li> <li>• Specialists</li> <li>• Social media</li> </ul>
3.2 Understand fire patterns and explain their significance at the scene of a fire	<ul style="list-style-type: none"> <li>• Burn patterns</li> <li>• Charring and calcination of wood</li> <li>• Melting of plastic and metal</li> <li>• Tempering of metal</li> <li>• Identifying point of origin</li> <li>• The 'Radius of Error'</li> <li>• Spalling</li> <li>• Protection marks</li> <li>• Soot deposits</li> <li>• The influence of firefighting media</li> </ul>
3.3 Understand and explain the significance of glazing when assessing evidence at a fire	<ul style="list-style-type: none"> <li>• Types of glass</li> <li>• Effects of heating glass</li> <li>• Evidence of impact on glass</li> <li>• Fire temperatures</li> <li>• Speed of fire growth</li> <li>• Evidence of explosion</li> <li>• Evidence from items other than windows made from glass</li> </ul>
3.4 Understand and explain the temperature indicators at a fire scene	<ul style="list-style-type: none"> <li>• Discolouration of fabrics</li> <li>• Blistering of surface finishes</li> <li>• Discolouration of stone and concrete</li> <li>• Flame colours</li> </ul>
3.5 Understand excavation and examination techniques applied at fire scenes	<ul style="list-style-type: none"> <li>• Protecting the scene</li> <li>• Layering of evidence</li> <li>• Zones and the grid approach</li> <li>• Useful tools and equipment</li> <li>• Clean areas</li> <li>• Reconstruction</li> <li>• External evidence (outside a building, vehicle etc.)</li> </ul>
3.6 Understand the nature and properties of accelerants and how they apply to fire scenes	<ul style="list-style-type: none"> <li>• Detection methods</li> <li>• Pour patterns</li> <li>• Use of accelerant detection dogs</li> <li>• Identifying pints for sampling</li> <li>• Sampling techniques</li> </ul>
3.7 Understand the role that electricity plays at a fire scene	<ul style="list-style-type: none"> <li>• Generation and supply</li> <li>• Electrical test equipment and techniques</li> <li>• Cables and cable types</li> <li>• Circuit protective devices</li> <li>• Short circuit conditions</li> </ul>

3.8 Explain the processes used for recording the scene	<ul style="list-style-type: none"> <li>• Written notes</li> <li>• Photography and video</li> <li>• Diagrams, sketches and plans</li> <li>• Managing evidence and exhibits</li> <li>• Packaging and transportation of evidence</li> <li>• Need to seek assistance</li> </ul>
3.9 Describe methods used to minimise the contamination at fire scenes	<ul style="list-style-type: none"> <li>• Forensic awareness</li> <li>• Protective clothing</li> <li>• Protection of evidence</li> <li>• Decontamination and cleaning of equipment and clothing</li> </ul>

## 4. Special Scenes

Assessment Objective	Knowledge, Understanding and Skills
4.1 Understand electrical causes of fire	<ul style="list-style-type: none"> <li>• Short circuit</li> <li>• Overload</li> <li>• Damage to cables and installations</li> <li>• Local resistance heating</li> <li>• Electrical arcing</li> <li>• Static electricity and lightning</li> <li>• Electrical appliances failures</li> <li>• Electrical intake (service head) fires</li> <li>• False indicators</li> <li>• Lost neutral</li> <li>• Photo-voltaic solar panels</li> </ul>
4.2 Assess the causes of vehicle and transport fires	<ul style="list-style-type: none"> <li>• Vehicle arson</li> <li>• Significance of vehicle compartments</li> <li>• Vehicle security</li> <li>• Fires in moving vehicles</li> <li>• Vehicles fuels and other flammable liquids</li> </ul>
4.3 Explain the approach to be followed at fatal fires	<ul style="list-style-type: none"> <li>• Multi-agency approach</li> <li>• Sensitivities of working at a fatal fire scene</li> <li>• Role of the Coroner</li> <li>• 'Reading' fire damage to a body</li> <li>• Identifying the deceased</li> <li>• Establishing cause of death</li> <li>• Reporting cause of fire and cause of death</li> </ul>
4.4 Explain the approach to be followed at the scene of an explosion and understand the evidence that can be obtained	<ul style="list-style-type: none"> <li>• Types of explosion</li> <li>• 'Reading' explosion damage</li> <li>• Mechanical or pneumatic/hydraulic explosions</li> <li>• Explosion scene management</li> <li>• Cordons and cordon control</li> <li>• Determining the point of initiation</li> <li>• Homemade explosive devices</li> <li>• Timers and initiators</li> </ul>
4.5 Understand and explain how to work with partners at crime scenes	<ul style="list-style-type: none"> <li>• Jurisdiction</li> <li>• Role of Police, Fire Service, Forensic</li> </ul>

	<p>Scientists and other investigators</p> <ul style="list-style-type: none"> <li>• Control of crime scenes</li> <li>• Agreeing responsibilities</li> </ul>
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## 5. Evidence

Assessment Objective	Knowledge, Understanding and Skills
5.1 Identify when fires may be due to arson and preserve evidence	<ul style="list-style-type: none"> <li>• Explain the reasons for suspecting arson as a cause of fire from things observed and information provided</li> <li>• Understand appropriate steps to take to preserve a scene where arson is expected</li> <li>• Appreciate when to ask for help from a more senior or experienced investigator</li> </ul>
5.2 Explain the use of contemporaneous notes at fire scenes	<ul style="list-style-type: none"> <li>• Importance of contemporaneous notes</li> <li>• Content of contemporaneous notes</li> <li>• 'Rules' for writing contemporaneous notes</li> </ul>
5.3 Explain the use of imaging at fire scenes	<ul style="list-style-type: none"> <li>• Working with digital images</li> <li>• Still photographs</li> <li>• Video/CCTV</li> </ul>
5.4 Explain the need for, and purpose of, forensic awareness	<ul style="list-style-type: none"> <li>• Protecting the scene</li> <li>• The role of the laboratory</li> <li>• Reconstructive fire testing</li> <li>• Non-destructive testing and examination</li> </ul>
5.5 Explain the role of professional witnesses	<ul style="list-style-type: none"> <li>• The role of an professional witness</li> <li>• The status and role of a professional witnesses in court</li> </ul>
5.6 Explain the purpose and content of written reports	<ul style="list-style-type: none"> <li>• Content and structure of reports</li> <li>• Possible appendices to a report</li> <li>• Disclosure</li> </ul>