IFE Level 4 Certificate in Fire Investigation

Qualification Specification

Qualification Number: 603/6616/3

About the Institution of Fire Engineers (IFE)

The IFE is the professional institution for those working in the fire sector. The IFE is a registered charity working for societal benefit. Founded in 1918, the IFE's mission is to promote, encourage and improve the science, practice and professionalism of fire engineering with the overall aim of protecting and saving lives.

Members of the IFE share a commitment to ensuring that the fire profession remains relevant and valued, protecting people, property and the environment from fire.

The IFE Awarding Organisation
The IFE's awarding organisation is non-profitmaking.

The aim of the of the awarding organisation is to encourage those who work in the sector to engage with, and develop, the critical understanding needed to operate effectively and safely and to the best professional standards so that they can protect and save lives. In doing this, the awarding organisation contributes to three of the IFE's (six) over-arching strategic priorities i.e.:

- Facilitate awareness of fire issues and developments through the communication of ideas, knowledge and information.
- Foster professionalism by establishing and maintaining pathways and recognised standards of fire professionalism and competency.
- Increase knowledge in the science, practice and professionalism of fire engineering.

All of the IFE's qualifications are designed for those working in the fire sector and to meet the above priorities. The qualifications and the associated assessments (examinations and practical activities/assignments) provided by the IFE are designed, assessed and quality assured by experts with extensive experience of working within the fire sector.

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IFE Level 4 Certificate in Fire Investigation

Introduction
This qualification focuses on the specialist technical understanding and knowledge required by those who carry out fire and explosion investigations. It covers the scientific principles that underpin the dynamics of fire as well as the associated processes of investigation and analysis.

This qualification is derived from unit 6: Fire Investigation within the Level 4 Diploma in Fire Science and Fire Safety. It is directly equivalent to that unit in that the content and assessment remain exactly the same. Individuals who achieve this qualification may use it towards the achievement of the Level 4 Diploma in Fire Science and Fire Safety. For information, please see - https://www.ife.org.uk/IFE-Qualifications-with-Syllabus-Links

Target Audience
This qualification will be appropriate for individuals working in fire investigation roles in either public sector or private sector employers.

Learning Outcomes
Candidates who achieve this qualification should be able to:

- apply fire science principles in carrying out fire investigations and arriving at conclusions
- 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
- apply understanding of combustion, fire dynamics and the effects of heat to explain issues and solve problems
- analyse information to produce conclusions based on evidence and fire science
- understand and apply the protocols for working safely at a fire scene and with associated evidence

Membership of the IFE
Achievement of this qualification enables candidates to meet the academic requirement for membership of the Institution at **Technician (TIFireE) Grade**.

Achievement of **three Level 4 Certificates** enables candidates to meet the academic requirement for membership of the Institution at **Associate (AIFireE) Grade** or **Member (MIFireE) Grade**.

To achieve the full **Level 4 Diploma**, candidates must complete this qualification **in addition to** the following:

- The mandatory Level 4 Certificate in Fire Engineering Science
- The mandatory Level 4 Certificate in Fire Safety
- One additional IFE Level 4 Certificate

All four qualifications must be achieved **within a five-year period**.

Qualification Content
The content of the qualification is set out in the section entitled "Content" below. This section provides information on the range of topics that must be studied including the way that candidates need to show their understanding (Assessment Criteria) and the scope/range/contexts in which they can be tested (Knowledge and Understanding).

The syllabus content is very broad and deep and therefore not all topics can be tested in all examinations. Candidates are advised to prepare for the examination by covering all topics so that they are able to provide comprehensive responses.

Assessment
The assessment takes the form of one three-hour examination and provides a summative assessment of the full range of learning specified in the content below.

Examinations are provided in English only.

Candidates will be required to complete **six** questions from a choice of **eight** questions. There will be 20 marks available for each of the questions.

In order to achieve a Pass, candidates will be required to attain at least 48 of the 120 marks available to them via the six questions.

Candidates who answer fewer than six questions will be able to achieve a Pass as long as they achieve the minimum pass mark of 48. Should candidates answer more than six questions, they will not benefit as only the six best responses will be included in the final mark.

Certification
Results of examinations will be reported as follows:

Pass - this is awarded where candidates achieve a mark between the minimum pass mark of 48 marks and 71 marks.
Distinction - this is awarded where candidates achieve a mark of 72 or above.
Fail - candidates who achieve 47 marks or fewer will receive a result showing Fail. Where candidates receive 24 marks or fewer, the result will show as Fail (X).

Candidates who are unsuccessful in the examination may re-sit the examination. There is no limit on the number of times that candidates may re-sit.

Candidates will be issued with the mark achieved out of a total of 120.

Entry Requirements
There are no formal entry requirements.
As the examination is provided in English only, candidates will need to have a comprehensive understanding of the English language in order to access the examination questions.

Qualification Level
This qualification has been designed to enable candidates to demonstrate that they have attained knowledge and understanding at Level 4. Other types of qualifications that are set at Level 4 include Certificate of Higher Education (CertHE), Higher National Certificate (HNC) and Level 4 NVQs.

The qualifications regulator, Ofqual, has provided the following descriptors to illustrate the knowledge and understanding expected from those who hold qualifications at Level 4.

Level 4 Knowledge Descriptor
The candidate:

- Has practical, theoretical, or technical knowledge and understanding of a subject or field of work to address problems that are well defined but complex and non-routine.
- Can analyse, interpret and evaluate relevant information and ideas.
- Is aware of the nature of approximate scope of the area of study or work.
- Has an informed awareness of different perspectives or approaches within the area of study or work.

Candidates are advised to bear these descriptors in mind when preparing for assessment and when composing responses to examination questions.

Qualification Learning Time
The length of time needed to prepare for this examination will vary depending upon the starting point for each candidate.

Total qualification time is 155 hours:

- 152 hours of learning/study. Study may be self-study (please see the section on recommended reading material below) and may include relevant employer training programmes or other work-related training.
- 3 hours of assessment (directed time) i.e. one three-hour examination.

Most candidates prepare for IFE examinations via self-study or by drawing on training provided by their employer that covers aspects of the syllabus. Candidates are advised to cross-map their study/training against the content of the syllabus to ensure that all parts of the syllabus have been covered. Recommended reading materials are provided below.

Progression
Candidates who are successful in achieving this qualification may consider progression to specialist degree programmes such as BSc in Fire Engineering Science.

Recommended Reading
This qualification covers an extensive range of contexts and candidates are advised to reflect this in their examination preparation.

Candidates are also advised to review past examination papers. Past papers, together with the associated examiner reports on the papers, can be downloaded, free of charge, from the IFE website - https://www.ife.org.uk/Qualifications/Past-Papers-and-Exam-Reports.

Candidates preparing for the examinations are advised to refer to the list below:

- Kirks Fire Investigation 8th edition, John D De Haan and David J Icove
- Fire Investigator – Principles and Practice to NFPA921 and 1033, Published by Jones and Bartlett Learning in conjunction with IAFC, IAAI and NFPA
- NFPA 921: Guide For Fire And Explosion Investigations
- Fire and rescue service: operational guidance for incidents involving hazardous materials - part 1 (publishing.service.gov.uk)

Content

1. Chemistry of Combustion and Fire Dynamics

Assessment Criteria	Knowledge and Understanding
1.1 Explain the physical processes involved in a fire	• Heat, temperature and the states of matter • Heat transfer • Flame height • Upper layer temperature • Radiative feedback
1.2 Explain the characteristics of different types of fire and their impact on investigation	• Characteristics of a flaming fire • Characteristics of a smouldering fire • Flashover and its impact on the investigation of a compartment fire
1.3 Understand the chemistry of fire	• Stoichiometric mixture • Flammability limits • Flash point and fire point • Radiation induced flashover • Flames • Combustion processes: ♦ Spontaneous heating ♦ Spontaneous ignition ♦ Spontaneous combustion • Combustion of solids, liquids, gases, transient dust and vapour phases • How and why substances/fuels burn • Magnification of the sun's rays • Smouldering combustion • Auto-ignition temperature
1.4 Describe the properties of common flammable materials and assess the implications in relation to fire	• Methane, propane, and butane • Acetylene • Hydrogen • Petroleum products • Paraffin • White spirit • Diesel oil • Ethanol (alcohol), methylated spirit, methanol (methyl alcohol) and isopropanol (2-propanol) • Plastic and chemicals that are used in plastic manufacturing industries • Rubbers (natural and synthetic) • Carbohydrates • Cellulose • Proteins • Fats • Wood • Metals • Natural and/or synthetic fabrics

1.5 Assess, applying fire science, the factors that affect accuracy in determining the location of a seat of fire	• Size of fire • Flashover • Smouldering • Firefighting procedures • Fuel load and its location relative to walls • Backdraught • Collapse • Burn patterns • Human or animal interaction
1.6 Understand the physical signs that can illustrate the general locality of a seat of fire and relate those signs to fire dynamics (radiation, convection, conduction, and heat plume)	• Low level burning • High level burning • Depth or severity of burning • Smoke spread • Patterning (heat/burn/smoke) • Glass fracture, melting, discolouration or staining • Heat effect on metals • Melting and degradation of plastics • Burning effects of timber • Calcination of plasterboard • Arc mapping

2. Electricity

Assessment Criteria	**Knowledge and Understanding**
2.1 Understand electricity and electrical causes of fire	• Ohm's law • Series and parallel circuits • Calculations involving voltage, current, resistance and power • Fault current • Earth fault loop impedance • Arc mapping techniques in origin determination • Lithium-ion batteries • Lost neutral • Single and three-phase electrical generation and supply • Fires involving white goods • Electrical fires as a result of meter tampering • Protective devices • Electrical cable types • Arcing • Resistive heating • Short circuits • Overload • Tracking/Arcing through char • Ways in which heat can be achieved in a circuit • Electrical causes of fire and the effects of fire in electrical equipment

2.2 Explain static electricity and how it can become a source of ignition	• Lightning – cause and effects • Static electricity – how it is generated • Properties of static electricity as an ignition source • Fuels capable of being ignited by static electricity

3. Investigating Fire Scenes

Note to candidates: fire scenes include buildings and transportation

Assessment Criteria	Knowledge and Understanding
3.1 Understand the effect that structures and voids have on a fire	• Structures: ♦ Buildings ♦ Road, rail, aviation and maritime modes of transportation and associated routes, spaces and equipment • Effects of ventilation • Effects of modern methods of construction on fires in moving vehicles • Timber framed buildings
3.2 Assess the effects that the contents of a building/structure have on a fire	• Traditional furniture • Modern furniture and furnishings • Floor and wall coverings • Transport loads • Concept of fire load density and orientation
3.3 Assess the effects that occupancy can have on a building/structure involved in fire	• Houses and other domestic residences • Factories • Chemical works • Hospitals and residential homes • Schools • Transportation • Human behaviour in fires
3.4 Outline the effects of firefighting on structure/contents involved in fire and assess the implications for fire investigation	• Water damage e.g., causing collapse • Movement or destruction of items by firefighting water • Dilution of liquids • Hotspots and areas of late extinguishment • Positive pressure ventilation
3.5 Explain and assess the organisational aspects of fire investigation	• Scene priorities • Range of resources to be used and their application • Potential and actual contamination of a scene • Evidence preservation • Possible hazards which may pose a risk to the fire investigator at a fire scene including: ♦ Collapse ♦ Sharps ♦ Trips and falls ♦ Chemicals ♦ Respiratory risks ♦ Lone working ♦ Biological/Chemical hazards

	• Dynamic Risk Assessment (DRA)
3.6 Describe and assess the aids, including their limitations, that are available to the fire investigator to detect hydrocarbons	• Dog • Portable equipment • Specialist sampling equipment • Detection, Identification and Monitoring (DIM)
3.7 Explain and assess the indirect methods of locating the seat of fire	• Observations of witnesses • Corroboration of witnesses • Reversal of fire fighting • Points of entry and exit • Position of bodies • Structural collapse • Knowledge of materials present
3.8 Explain and evaluate the methods used to carry out the investigation	• Reconstruction • Fact finding and testing • Excavation including: ♦ Extraneous items and materials ♦ Fire accelerants (liquid and dry) ♦ Liquid burn patterns ♦ Significant items and materials • Study of pre-fire events ♦ History ♦ Odours ♦ Changes ♦ Weather ♦ Disputes • Explain and apply the term “radius of error”

4. Special Fire Scenes

Assessment Criteria	**Knowledge and Understanding**
4.1 Explain the fundamental features of an investigation when a person dies as a result of fire	• Evidence that needs to be collected to establish the location of death and when and how the deceased died • Factors which would lead an investigator to recognise a death in fire as a murder, suicide, or an accident
4.2 Explain the factors to be considered when dealing with fatalities	• Ways in which the deceased may be identified • Points to consider when removing bodies at fire scenes • Effect of fire on bodies and factors affecting damage • Basic medical terminology that may be encountered during an investigation and subsequent post-mortem • Recovery of evidence and liaison with appropriate personnel • How to avoid causing unnecessary stress and treating deceased with due regard

4.3 Explain the types of explosions that may occur and the materials that can be involved in explosions	• Types of Explosion: ♦ Detonation ♦ Deflagration ♦ Mechanical • Smoke explosion • High Explosives • Condensed Phase Deflagration • Dispersed explosion • Pyrotechnics • Ventilation induced flashover • Importance of preservation of evidence of an explosion and the procedure for searching for the remains of a high explosive device • "Reading" explosion damage • Explosion scene management • Determining the point of initiation • "Homemade" explosive devices • Timers and initiators • Mechanical and chemical explosions • Low order and high order damage
4.4 Explain the fundamental principles of investigating a wildland fire	• Origin determination • Effects of terrain, weather etc • Determining direction of fire spread • Common Causes

5. Recording, Collecting and Testing of Information and Evidence

Assessment Criteria	**Knowledge and Understanding**
5.1 Explain the type of information that is required to develop a full and comprehensive report	• Cause and origin • Fire spread • Background • Findings • Conclusion • Recommendations
5.2 Outline the ways and methods used to collect information and assess the advantages and disadvantages of each method	• Observation • Research • Interview • Witnesses • IT examination (including CCTV, AFD and mobile phone data) • Use of forensic specialists • Use of forensic accountants
5.3 Identify evidence at the scene of a fire and analyse its significance	• Glass • Smoke records • Evidence from instrument marks, footwear impressions and tyre marks • Indicators which may suggest the presence of an ignitable liquid • Potential ignition sources

5.4 Explain the use of trace evidence found at fire scenes including directional evidence	• Radiation effect • Blast • Travel via voids • Fire/Smoke/Heat movement patterns
5.5 Describe the recording of information relating to the positions of movable objects and fire seat location	• Drawings • Notes • Photographs • Witness marks • Reconstruction
5.6 Explain the process of effective interviewing of a witness and assess the evidence provided by different types of witness	• Define the terms “lay witness” and “expert witness” • Formal/informal approaches • Legal caution • Putting witnesses at ease • PEACE model • ADVOCATE model
5.7 Describe the specific factors to be considered by the investigator when taking photographs at a fire scene to ensure clear and readable images which may be presented as evidence in a court of law	• Photo Log – no deletions (accepted protocols if available) • Accurate date/time • Personal photographic ability • Zoom in/out for location of points of interest • Logical sequence of images • No finger pointing • Use tape measure or standard template square • Storage of images
5.8 Identify where fires may be due to arson and present evidence	• Reasons for suspecting arson as a cause of fire from the general circumstances • Reasons for suspecting arson at or after the investigation of the scene of fire • Types and classifications of persons who set fires
5.9 Explain how to evaluate information to form and test hypotheses	• Compilation methods • Interpretation of results • Identification of inconsistencies • How to qualify conclusions • How actual fire safety measures and practices, or lack of same, contributed to the incident
5.10 Assess the methods and equipment for handing and storing evidence to preserve continuity, avoid damage and cross contamination	• Importance of maintaining continuity records • Methods of provision for secure storage and transportation • Precautions to prevent cross contamination of evidence and scenes
5.11 Explain the taking and examination of fire debris samples	• The chain of continuity for law • Avoidance of contamination
5.12 Explain the principles of laboratory analysis of material and samples collected at the scene of fire	• Incendiary devices • Containers • Clocks and watches • Hair and clothing • Paint • Other articles and evidence that may be found at a fire scene

	• Fuels and fire accelerants – hydrocarbons • Fuels and fire accelerants – non-hydrocarbons • Toxic combustion products