SQA Advanced Unit Specification

General information for centres

Unit title: Fire and Gas Detection

Unit code: HV4L 47

Unit purpose: This unit is designed to enable candidates to gain knowledge and understanding of fire and gas detection systems used to protect process plant and personnel, by being able to explain the operation, and know the applications of the different types of fire and gas detection systems commonly found in industrial process plant.

On completion of the unit the candidate should be able to:

1 explain the hazards associated with combustible and toxic substances
2 explain the operation and optimum location of various types of fire detectors
3 explain the operation and optimum location of various types of gas detectors
4 explain the operation of typical fire and gas detection systems

Credit points and level: 1 SQA Credit at SCQF level 7: (8 SCQF credit points at SCQF level 7*).

**SCQF credit points are used to allocate credit to qualifications in the Scottish Credit and Qualifications Framework (SCQF). Each qualification in the Framework is allocated a number of SCQF credit points at an SCQF level. There are 12 SCQF levels, ranging from National 1 to Doctorates.*

Recommended prior knowledge and skills: Access to this unit will be at the discretion of the centre and the following recommendations are for guidance only. Candidates should have a basic knowledge of process measurement and control engineering. This may be evidenced by the possession of the Higher courses Process Measurement or Process Control or NQ Units in Measurement and Control or NC Measurement and Control or NC Multidisciplinary Engineering.

Core skills: There are opportunities to develop the core skills of Written Communication (Writing) and Written Communication (Reading) at SCQF level 5 in this unit, although there is no automatic certification of core skills or core skills components.

Context for delivery: If this unit is delivered as part of a group award, it is recommended that it should be taught and assessed within the subject area of the group award to which it contributes.

Assessment: The assessment for Outcome 1, Outcome 2, Outcome 3 and Outcome 4 in this unit can be assessed separately by one hour assessments or integrated into one end-of-unit assessment lasting not more than three hours. The end-of-unit assessment should be taken by candidates at one single assessment event. The assessment paper should be composed of a suitable balance of short-answer, restricted-response and structured questions.

This assessment should be conducted under controlled, supervised conditions.

The assessment should be carried out at the end of the delivery of the unit.

Outcome 3 may be assessed by a practical assignment.

It should be noted that the candidates must achieve all the minimum evidence specified for each outcome in order to pass the unit.

SQA Advanced Unit specification: statement of standards

Unit title: Fire and Gas Detection

Unit code: HV4L 47

The sections of the unit stating the outcomes, knowledge and/or skills, and evidence requirements are mandatory.

Where evidence for outcomes is assessed on a sample basis, the whole of the content listed in the knowledge and/or skills section must be taught and available for assessment. Candidates should not know in advance the items on which they will be assessed and different items should be sampled on each assessment occasion.

Outcome 1

Explain the hazards associated with combustible and toxic substances

Knowledge and/or skills

- The fire triangle
- Flash point, fire point and auto-ignition temperature
- Flammable range
- Oxygen enrichment
- Density and relative density
- Hazardous area classification to Atex 137
- Gas grouping for groups 1 and 11
- Toxic substances as defined in the present COSHH regulations

Evidence requirements

Evidence for the knowledge and/or skills in this outcome will be provided on a sample basis and be presented in response to specific questions. Each candidate will need to demonstrate that they can answer correctly questions based on a sample of the items shown above. In any assessment of this Outcome six out of eight knowledge and/or skills should be sampled.

In order to ensure candidates will not be able to foresee the items in which they will be questioned on a different sample of six knowledge and/or skills is to be used each time the outcome is assessed. Candidates must provide a satisfactory response to all six knowledge and/or skills items. When sampling takes place a candidate response can be judged satisfactory where evidence provided is sufficient to meet the requirement for each item by showing that the candidate is able to:

- explain the fire triangle
- explain flash point, fire point and auto-ignition temperature
- explain flammable range
- explain oxygen enrichment
- explain density and relative density
- explain hazardous area classification to Atex 137
- explain gas grouping for groups 1 and 11
- explain toxic substances as defined in the present COSHH regulations

Evidence should be generated through assessment undertaken in controlled supervised conditions.

Assessment guidelines

Assessments should be conducted under closed-book conditions and as such candidates should not be allowed to bring any textbooks, handouts or notes to the assessment.

Questions used to elicit candidate evidence should take the form of an appropriate balance of short-answer questions, restricted-response questions and structured questions.

The assessment for Outcome 1 can be assessed separately by one hour assessment or integrated with Outcomes 2, 3 and 4 into one end-of-unit assessment lasting not more than three hours. The end-of-unit assessment should be taken by candidates at one single assessment event.

Outcome 2

Explain the operation and optimum location of various types of fire detectors

Knowledge and/or skills

- flame detectors
- heat detectors
- smoke detectors

Evidence requirements

Evidence for the knowledge and/or skills in this outcome will be provided on a sample basis and be presented in response to specific questions. Each candidate will need to demonstrate that he/she can answer correctly questions based on a sample of the items shown above. In any assessment of this Outcome, two out of three knowledge and/or skills should be sampled.

In order to ensure candidates will not be able to foresee the items in which they will be questioned on a different sample of two knowledge and/or skills is to be used each time the outcome is assessed. Candidates must provide a satisfactory response to all two knowledge and/or skills. When sampling takes place a candidate response can be judged satisfactory where evidence provided is sufficient to meet the requirements for each item by showing that the candidate is able to:

- explain the basic construction, operation, behaviour, optimum location and general maintenance procedures of flame detectors
- explain the basic construction, operation, behaviour, optimum location and general maintenance procedures of heat detectors
- explain the basic construction, operation, behaviour, optimum location and general maintenance procedures of smoke detectors

Evidence should be generated through assessment undertaken in controlled supervised conditions.

Assessment guidelines

Assessment should be conducted under closed-book conditions and as such candidates should not be allowed to bring textbooks, handouts or notes to the assessment.

Questions used to elicit candidate evidence should take the form of an appropriate balance of short-answer questions, restricted-response questions and structured questions.

The assessment for Outcome 2 can be assessed separately by one hour assessment or integrated with Outcomes 1, 3 and 4 into one end-of-unit assessment lasting not more than three hours. The end-of-unit assessment should be taken by candidates at one single assessment event.

Outcome 3

Explain the operation and optimum location of various types of gas detectors

Knowledge and/or skills

- catalytic detectors
- infrared detectors
- semiconductor detector
- general calibration procedures

Evidence requirements

Evidence for the knowledge and/or skills in this outcome will be provided on a sample basis and be presented in response to specific questions. Each candidate will need to demonstrate that he/she can answer correctly questions based on a sample of the items above. In any assessment of this outcome three out of four knowledge and/or skills will be sampled.

In order to ensure candidates will not be able to foresee the items in which they will be questioned on a different sample of three knowledge and/or skills will be used each time the outcome is assessed. Candidates must provide a satisfactory response to all three knowledge and/or skills. When sampling takes place a candidate response can be judged satisfactory where evidence provided is sufficient to meet the requirements for each item by showing that the candidate is able to:

- explain the basic construction and operation of catalytic detectors
- explain the basic construction and operation of infrared detectors
- explain the basic construction and operation of semiconductor detectors
- carry out general calibration procedures for ONE of the above detectors

Evidence should be generated through assessment taken under controlled supervised conditions, in which calibration procedure can be either an explanation or a practical calibration by the candidate.

Assessment guidelines

Assessment should be conducted under closed-book conditions and as such candidates should not be allowed to bring textbooks, handouts or notes to the assessment.

Questions used to elicit candidate evidence should take the form of an appropriate balance of short-answer questions, restricted-response and structured questions.

The assessment for Outcome 3 can be assessed separately by one hour assessment or integrated with Outcomes 1, 2 and 4 into one end-of-unit assessment lasting not more than three hours. The end-of-unit assessment should be taken by candidates at one single assessment event.

Outcome 4

Explain the operation of typical fire and gas detection system

Knowledge and/or skills

- The basic function of the components parts of a fire and gas detection system with respect to safe plant shutdown

- Principle of operation of large-scale extinguishant systems
- The typical executive decisions and actions taken by a fire and gas detection system
- The function of the complete fire and gas detection system when activated

Evidence requirements

Evidence for the knowledge and/or skills in this outcome will be provided on a sample basis and be presented in response to specific questions. Each candidate will need to demonstrate that he/she can answer correctly questions based on a sample of the items shown above. In any assessment of this Outcome three out of four knowledge and/or skills should be sampled.

In order to ensure candidates will not be able to foresee the items in which they will be questioned on a different sample of two knowledge and/or skills is to be used each time the outcome is assessed. Candidates must provide a satisfactory response to all three knowledge and/or skills. When sampling takes place a candidate response can be judged satisfactory where evidence provided is sufficient to meet the requirements of each item by showing that the candidate is able to:

- explain the basic function of the component parts of a fire and gas detection system with respect to safe plant shutdown
- explain the principle of operation of large-scale extinguishant systems
- explain the typical executive decisions and actions taken by a fire and gas detection system
- explain the function of the complete fire and gas detection system when activated

Evidence should be generated through assessment taken in controlled supervised conditions.

Assessment guidelines

Assessment should be conducted under closed-book conditions and as such candidates should not be allowed to bring textbooks, handbooks or notes to the assessment.

Questions used to elicit candidate evidence should take the form of an appropriate balance of short-answer question, restricted-response questions and structured questions.

The assessment for Outcome 4 can be assessed separately by one hour assessment or integrated with Outcomes 1, 2 and 3 into one end-of-unit assessment lasting not more than three hours. The end-of-unit assessment should be taken by candidates at one single assessment event.

Administrative information

Unit code: HV4L 47

Unit title: Fire and Gas Detection

Superclass category: VG

Original date of publication: November 2017

Version: 01

History of Changes:

Version	Description of change	Date

Source: SQA

SQA acknowledges the valuable contribution that Scotland's colleges have made to the development of SQA Advanced Qualifications.

For further information, please call SQA's Customer Contact Centre on 44 (0) 141 500 5030 or 0345 279 1000. Alternatively, complete our Centre Feedback Form.

SQA Advanced Unit Specification: support notes

Unit title: Fire and Gas Detection

This part of the unit specification is offered as guidance. The support notes are not mandatory.

While the exact time allocated to this unit is at the discretion of the centre, the notional design length is 40 hours.

Guidance on the content and context for this unit

This unit has been written in order to allow candidates to develop knowledge, understanding and skills in the following areas:

1 Explain the hazards associated with combustible and toxic substances
2 Explain the operation and optimum location of various types of fire detectors
3 Explain the operation and optimum location of various types of gas detectors
4 Explain the operation of typical fire and gas detection systems.

The unit is at SCQF level 7 and the unit has been developed as part of the SQA Advanced Certificate/Diploma in Measurement and Control Engineering. However this does not preclude the use of this unit in other awards where award designers feel it is appropriate.

In designing this unit, the writer has identified the range of topics that they would expect to be covered by lecturers. The writer has also given recommendations as to how much time should be spent on each outcome. This is done to help lecturers to decide what depth of treatment should be given to the topics attached to each outcome.

A list of topics for each outcome is given below.

The knowledge and skills of each outcome could be supported by practical work where relevant.

Outcome 1 (6 hours)

Explain the hazards associated with combustible and toxic substances.

- Typically Hydrogen Sulphide, H_2S
- The fire triangle, flash point, fire point and auto-ignition temperature
- Flammable range, oxygen enrichment, density/relative density
- Hazardous area classification to Atex 137
- Gas grouping for groups 1 and 11
- Temperature classification
- Toxic substances as defined in the present COSHH regulations

Outcome 2 (8 hours)

Explain the operation and optimum location of various types of fire detectors.

- The basic construction and operation of flame detectors
- The basic construction and operation of heat detectors
- The basic construction and operation of smoke detectors
- Explain the behaviour of the above detectors with given toxic substances
- Detector response times and interfaces
- Explain the optimum location of each type of detector
- General maintenance procedures for each of the above types of detector. Use of test equipment to verify the operation of smoke, flame and heat detection systems

Outcome 3 (14 hours)

Explain the operation and optimum location of various types of gas detectors.

- The basic construction and operation of catalytic detectors
- The basic construction and operation of infrared detectors
- The basic construction and operation of semiconductor detectors
- Detector response times and interfaces
- Explain the behaviour of the above detectors with given gases and toxic substances
- Explain the optimum location of each type of detector
- General calibration procedures for each of the above types of detector (this could be a written explanation or a practical calibration). Checks relating to calibration and fault location on gas detection systems — voltages, operating current using calibration gas, loop fault current or alarm settings

Outcome 4 (12 hours)

Explain the operation of typical fire and gas detection system.

- The basic function of the component parts of a fire and gas detection system with respect to safe plant shutdown
- Combined safety systems — process and emergency shutdown systems (PSD/ESD), fire and gas systems (F&G) and process control systems (PCS). Integration of PCS, PSDICSD and F&G to Distributed Control Systems
- Principle of operation of large-scale extinguishant systems (halon replacement — need to extinguish fire quickly and safely, agents available — CO_2, oxygen, nitrogen, foams, dry powders, wet chemicals and water mist)
- The typical executive decisions and actions taken by a fire and gas detection system
- The function of the complete fire and gas detection system when activated. Automatic fire suppression — to protect area from fire damage. Two zones of detection used to fire detection and extinguishing control panel. Fire trace — self activating system, no electronics/moving parts, principle of operation, advantages and applications
- Cause and effect matrix (CEM) logic types and us as tool to document safety requirement of safe instrumentated systems. Translation of cause and effect matrix into a safety system. CEM and PLO logic. Enhanced logic capability and use of enhanced safety matrix
- Prepare procedures — pager activation, general alarm evacuation and fire dept. notification

Outcomes 1, 2, 3 and 4 can be assessed separately as one hour assessments or integrated into a single, closed-book end test of not more than three hours.

Guidance on the delivery and assessment of this unit

This unit is designed to enable candidates to gain knowledge and understanding of fire and gas detection systems used to protect process plant and personnel, by being able to explain the operation, and know the applications of the different types of fire and gas detection systems commonly found in industrial process plant.

The content of the outcomes means that they should be delivered in order.

Candidates should have access to fire detectors and gas detectors and, if possible, a fire and gas system with control panel.

Details on approaches to assessment are given under evidence requirements and assessment guidelines under each outcome in the SQA Advanced Unit Specification: statement of standards section. It is recommended that these sections be read carefully before proceeding with assessment of candidates.

Opportunities for developing core skills

There are opportunities to develop the core skills of Written Communication (Writing) and Written Communication (Reading) at SCQF level 5 in this unit, although there is no automatic certification of core skills or core skills components.

Open learning

This unit could be delivered by distance learning, which may incorporate some degree of online support. With regard to assessment, planning would be required of the centre concerned to ensure the sufficiency and authenticity of candidate evidence. Arrangements would be required to be put in place to ensure that assessments were conducted under controlled, supervised conditions. Agreement would have to be made to ensure that a single assessment for the end test is delivered in a supervised environment under controlled conditions.

Arrangements would need to be made to ensure that the candidate could perform practical work. This could involve the candidate attending the centre. Alternatively, special arrangements could be made for the candidate to demonstrate the practical work to a designated, responsible person local to the candidate.

For information on open learning, please refer to *SQA guide assessment and quality assurance of open and distance learning (A1030, Feb 2001).*

Equality and inclusion

This unit specification has been designed to ensure that there are no unnecessary barriers to learning or assessment. The individual needs of learners should be taken into account when planning learning experiences, selecting assessment methods or considering alternative evidence.

Further advice can be found on our website www.sqa.org.uk/assessmentarrangements.

General information for candidates

Unit title: Fire and Gas Detection

This unit has been designed to allow you to develop knowledge, understanding and skills associated with fire and gas detection systems used in industry to protect personnel, plant and the environment.

The early part of the unit deals with the hazards associated with combustible and toxic substances and should provide you with a good knowledge in this subject area.

The unit will also enable you to gain an understanding about of the different types of fire detectors commonly used along with the different types of gas detectors in use. For both fire and gas detectors, positioning along with maintenance and calibration procedures will also be covered.

In the final part of the unit you will see how the fire and gas detection systems work together, along with the plant shutdown and fixed fire fighting systems, along with the associated logic and decision making that is carried out by the systems when a fire or gas leak is detected.

The formal assessment for this unit will consist of a written assessment. Outcomes 1, 2, 3 and 4 will be a written assessment paper that will last no longer than three hours. This assessment will take place under controlled, supervised conditions in which you will not be allowed to take notes, handouts, textbooks, etc. into the assessment.

The written assessments will normally be carried out at the end of the delivery of the unit.