

## **SQA Advanced Unit Specification**

### **General information for centres**

**Unit title:** Instrumentation in Hazardous Areas

**Unit code:** HV65 47

**Unit purpose:** This Unit is designed to enable candidates to gain knowledge and understanding of instrumentation in hazardous areas and apply that knowledge to industrial situations.

On completion of this Unit the candidates should be able to:

- 1 Define hazardous atmospheres and hazardous area classification.
- 2 Explain possible sources of ignition.
- 3 Explain methods of Ex protection to Atex 100a.
- 4 Selection and testing of barrier devices.

**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 Higher Process Measurement or Higher 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), Written Communication (Reading) and Working with Others 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.

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**Assessment:** The assessment for Outcomes 1, 2, 3 and 4 should be individual assessment papers and each should last one hour. Or alternatively the assessments for Outcomes 1, 2 and 3 can be integrated into an end of Unit assessment lasting 3 hours. An assessment paper and a practical assignment will assess Outcome 4. The assessment papers should be composed of a balance of short answer, restricted response and structured questions. The assessments should be conducted under controlled supervised conditions.

**Unit specification: statement of standards**

**Unit title:** Instrumentation in Hazardous Areas

**Unit code:** HV65 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**

Define hazardous atmospheres and hazardous area classification

**Knowledge and/or skills**

- ◆ The fire triangle
- ◆ Flash point, fire point and auto-ignition temperature
- ◆ Flammable range
- ◆ Oxygen enrichment
- ◆ Hazardous area classification to Atex 137
- ◆ Gas grouping for groups 1 and 11

**Evidence Requirements**

Evidence for the knowledge and/or skills in this Outcome will be provided on a sample basis. The evidence may be provided in response to specific questions.

Each candidate will need to demonstrate that they can answer questions based on a sample of the items shown above.

In any assessment four out of the six knowledge and/or skills should be sampled.

In order to ensure that candidates will not be able to foresee what items they will be questioned on, a different sample of four out of the six knowledge and/ or skills is required each time the Outcome is assessed.

Candidates must provide a satisfactory response to all four items.

Where sampling takes place, a candidate's response can be judged to be satisfactory where evidence provided is sufficient to meet the requirements for each item by showing that the candidate is able to:

- ◆ explain the fire triangle
- ◆ define flash point, fire point and auto-ignition temperature
- ◆ explain flammable/explosive range, lower explosive and upper explosive limits
- ◆ explain oxygen enrichment and the hazards associated with it

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- ◆ define hazardous areas (Zone 0, 1 and 2 for gas and Zones 20, 21 and 22 for flammable dusts)
- ◆ explain gas grouping

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

### **Assessment guidelines**

Assessments should be conducted under closed book conditions and as such candidates must not be allowed any text books, handouts or notes in the assessment. Questions used to elicit candidate evidence may take the form of short answer or restricted response questions.

The assessment for Outcome 1 could be an individual assessment paper lasting one hour, or alternatively the assessment for Outcome 1 can be integrated with Outcomes 2 and 3 into an end of Unit assessment lasting three hours.

## **Outcome 2**

Explain possible sources of ignition

### **Knowledge and/or skills**

- ◆ Heat sources
- ◆ Electrical sources including static discharge
- ◆ Chemical sources
- ◆ Spontaneous combustion

### **Evidence Requirements**

Evidence for the knowledge and/or skills in this Outcome will be provided on a sample basis. The evidence may be provided in response to specific questions.

Each candidate will need to demonstrate that they can answer questions based on a sample of the items shown above.

In any assessment three out of the four knowledge and/or skills should be sampled.

In order to ensure that candidates will not be able to foresee what items they will be questioned on, a different sample of three out of the four knowledge and/or skills is required each time the Outcome is assessed.

Candidates must provide a satisfactory response to all three items.

Where sampling takes place, a candidate's response can be judged to be satisfactory where evidence provided is sufficient to meet the requirements for each item by showing that the candidate is able to:

- ◆ explain how heat sources may occur
- ◆ explain how electrical equipment could be a source of ignition
- ◆ explain how chemical sources of ignition could occur
- ◆ explain how spontaneous combustion could occur

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

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### Assessment guidelines

Assessments should be conducted under closed book conditions and as such candidates must not be allowed any textbooks, handouts or notes in the assessment. Questions used to elicit candidate evidence may take the form of short answer or restricted response questions.

The assessment for Outcome 2 could be an individual assessment paper lasting one hour, or alternatively the assessment for Outcome 2 can be integrated with Outcomes 1 and 3 into an end of Unit assessment lasting three hours.

### Outcome 3

Explain methods of Ex protection.

#### Knowledge and/or skills

- ◆ Prevention of explosive atmosphere — Ex o, Ex p, Ex m
- ◆ Suppression of flame propagation — Ex d, Ex q
- ◆ Ignition avoidance/removal — Ex e, Ex i, Ex n
- ◆ Special purpose — Ex s
- ◆ Temperature classification

#### Evidence Requirements

Evidence for the knowledge and/or skills in this Outcome will be provided on a sample basis. The evidence may be provided in response to specific questions.

Each candidate will need to demonstrate that they can answer questions based on a sample of the items shown above.

In any assessment four out of the five knowledge and/or skills should be sampled.

In order to ensure that candidates will not be able to foresee what items they will be questioned on, a different sample of four out of the five knowledge and/or skills is required each time the Outcome is assessed.

Candidates must provide a satisfactory response to all four items.

Where sampling takes place, a candidate's response can be judged to be satisfactory where evidence provided is sufficient to meet the requirements for each item by showing that the candidate is able to:

- ◆ explain the operation of an Ex method that works by prevention of an explosive atmosphere
- ◆ explain the operation of an Ex method that works by suppression of flame propagation
- ◆ explain the operation of an Ex method that works by ignition avoidance/ removal
- ◆ explain what is meant by "Special purpose" Ex protection
- ◆ explain temperature classification

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

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### **Assessment guidelines**

Assessments should be conducted under closed book conditions and as such candidates must not be allowed any text books, handouts or notes in the assessment. Questions used to elicit candidate evidence may take the form of short answer or restricted response questions.

The assessment for Outcome 3 could be an individual assessment paper lasting one hour, or alternatively the assessment for Outcome 3 can be integrated with Outcomes 1 and 2 into an end of Unit assessment lasting three hours.

### **Outcome 4**

Selection and testing of barrier devices

#### **Knowledge and/or skills**

- ◆ Need for barriers in hazardous areas
- ◆ Operation of barriers
- ◆ Selection of suitable barriers for a given application
- ◆ Testing of barriers to confirm correct operation

#### **Evidence Requirements**

Candidates will require evidence to demonstrate their skills and/or knowledge by showing that they can:

- ◆ explain the need for barriers in hazardous areas
- ◆ explain the operation of barriers
- ◆ select suitable barriers for a given application
- ◆ test barriers to confirm correct operation

Evidence should be generated through a practical assessment with checklist undertaken in controlled supervised conditions and either a closed book assessment or a case study.

A practical assessment with checklist will be used to confirm knowledge and/or skills of testing of barriers. The candidate will be given an industrial situation and technical data from which to choose a suitable barrier. The candidate will test the barrier and confirm correct operation.

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### Administrative information

<b>Unit code:</b>	HV65 47
<b>Unit title:</b>	Instrumentation in Hazardous Areas
<b>Superclass category:</b>	VG
<b>Original date of publication:</b>	November 2017
<b>Version:</b>	01

### History of Changes:

Version	Description of change	Date

**Source:** SQA

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## SQA Advanced Unit Specification

### Unit specification: support notes

#### Unit title: Instrumentation in Hazardous Areas

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 Hazardous atmospheres and hazardous area classification.
- 2 Possible sources of ignition.
- 3 Methods of Ex protection.
- 4 Selection and testing of barrier devices.

The Unit is at SCQF level 7 and has been developed as part of the SQA Advanced Certificate/ Diploma in Measurement and Control Engineering award. 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:

#### Outcome 1

Define hazardous atmospheres and hazardous area classification (10 hours)

- ◆ The fire triangle — each component essential for combustion and how removal of any one component can be used for fire-fighting.
- ◆ Flash point, fire point and auto-ignition temperature — how increasing temperature affects substances.
- ◆ Flammable or explosive range — lower and upper explosive limits and minimum ignition energy.
- ◆ Oxygen enrichment — how it may occur and what effect it has.
- ◆ Hazardous area classification — definition of hazardous areas including three-dimensional nature of hazardous areas. Use of standard IEC60079-10 for gas and IEC61241-3 for dusts.
- ◆ Atex 137 “Worker Safety” Directive.
- ◆ Vapour density — lighter than air or heavier than air gases.
- ◆ Explosive pressure — if an explosion does occur, what pressures are expected.
- ◆ Gas groupings — difference in groups for mining and surface operation — Group 1 and 11.



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### Outcome 2

Explain possible sources of ignition (11 hours)

- ◆ Hot surfaces — from exhausts, equipment failure, friction, impact, compressive action, chemical reactions and electrostatic discharge. How these can be hazardous and how they can be avoided.
- ◆ Sparks — from electrical equipment, rotating equipment, static electricity and lightning discharge.
- ◆ Naked flames — from cutting/welding equipment etc and as the result of a fire/explosion.
- ◆ Spontaneous combustion— of organic compounds and by reaching auto-ignition temperature of a substance.

### Outcome 3

Describe methods of Ex protection to Atex 100a (12 hours)

- ◆ Requirements to meet Atex directive 100a
- ◆ Different methods of explosion avoidance
- ◆ Prevention of explosive atmosphere:
  - Ex o — use of oil to prevent gas reaching arcing of high voltage contacts
  - Ex p — use of positive pressure to prevent ingress of gas
  - Ex m — use of encapsulation to prevent gas reaching electronic components
- ◆ Suppression of flame propagation
  - Ex d — flame proof enclosure prevents internal explosion reaching explosive atmosphere outwith enclosure
  - Ex q — quartz or sand filled enclosure quench any internal flame
- ◆ Ignition avoidance/removal
  - Ex e — increased safety of components prevent ignition
  - Ex n — non-incendive equipment that does not produce sparking
  - Ex i — intrinsic safety of equipment using low voltage and low current to reduce energy available to below minimum ignition energy
- ◆ Special purpose
  - need for certification of equipment which is new or unusual designs
- ◆ Use of earthing in IS systems — IS safety earths, IS instrument earth, power earthing and installation of IS earth
- ◆ Use of Zener barriers and Zener barrier testing
- ◆ Live working, inspection and maintenance of IS systems
- ◆ Ability of electrical systems to store energy
- ◆ Temperature classification – need to ensure that surface temperature is below auto-ignition temperature
- ◆ Ingress protection — protection against ingress of foreign bodies and water – degree of protection 0–8
- ◆ Combined methods of protection

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### Outcome 4

Selection and testing of barrier devices (7 hours)

- ◆ Need for barriers when using electrical equipment in hazardous areas
- ◆ Operation of barriers — Zener type
- ◆ How to select a suitable barrier for a given application
- ◆ How to test a barrier to confirm correct operation
  - Open circuit test
  - Short circuit test
  - High voltage test

The assessment for Outcomes 1, 2, 3 and 4 should be individual assessment papers and each should last one hour. Or alternatively the assessments for Outcomes 1, 2 and 3 can be integrated into an end of Unit assessment lasting three hours. An assessment paper and a practical assignment lasting one hour will assess Outcome 4.

### Guidance on the delivery and assessment of this Unit

It is intended that this Unit is presented in the context of applying explosion and fire prevention while using instrumentation in hazardous areas.

In the delivery candidates should have access to industrial plant with suitable Ex protection in place and barriers for testing.

This Unit has been written to incorporate sufficient time to allow the lecturer to teach, in a student centred way, the factors that can contribute towards explosion and methods used to prevent explosion.

The content of the Outcomes means that they should be delivered in order. There will be a short practical assessment as part of Outcome 4.

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), Written Communication (Reading) and, Problem Solving (Critical Thinking) 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 on-line 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. Arrangements would need to be made to ensure that the candidate could perform practical work. This could involve the candidate attending the centre or utilising video conferencing. 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](http://www.sqa.org.uk/assessmentarrangements).

### General information for candidates

#### **Unit title:** Instrumentation in Hazardous Areas

This Unit has been designed to provide you with knowledge and skills that will enable you to understand the hazards associated with using instrumentation in potentially hazardous areas and how the equipment can be protected to avoid explosion and fire. You will refer to the relevant regulations throughout this Unit and also use manufacturers' data.

This Unit will be assessed using four separate written assessments, each lasting approximately one hour and will be undertaken under supervised conditions. You will not be allowed to take notes, handouts, textbooks, etc. into the assessment. There will also be a short practical assessment.

In Outcome 1 you will learn about the fire triangle and how it relates to industrial situations. You will also learn about how temperature affects substances (flash point, fire point and auto-ignition temperature). You will also cover how oxygen enrichment can occur and the effect it can have. You will learn about hazardous area classifications and also how gas grouping is used. You will also learn how the concentration of a gas in air affects whether or not it will burn (explosive limits).

In Outcome 2 you will learn some of the different ways that ignition can take place, looking at different sources of ignition and how they could occur.

In Outcome 3 you will learn how explosion/ fire can be avoided when using electronic equipment in potentially hazardous areas. You will learn different techniques used by manufacturers to ensure that the instrumentation is safe to use.

In Outcome 4 you will learn about the need for and use of barriers when using electrical equipment in hazardous areas. You will also learn how to specify a barrier for a given application and how to test a barrier.