

## **SQA Advanced Unit Specification**

### **General information for centres**

**Unit title:** Process Analysers: On Line

**Unit code:** HV69 47

**Unit purpose:** This Unit is designed to enable candidates to gain knowledge and understanding of analysers used as part of process control systems, by being able to explain the operation, and know the applications of the different types of analysers commonly found in industrial process control systems.

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

- 1 Explain sampling systems as applied to on line analysers.
- 2 Explain the operation of on line electro-chemical type analysers.
- 3 Explain the operation of on line inferential type analysers.
- 4 Explain the operation of on line electro-magnetic type analysers.

**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) 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.

## **SQA Advanced Unit Specification**

**Assessment:** The assessment for Outcomes 1, 2, 3 and 4 in this Unit can be assessed separately by a one hour assessment for each Outcome OR integrated into one end of Unit assessment paper lasting three hours. This paper should be taken by candidates at one single assessment event that should last three hours. The assessment paper should be composed of a suitable balance of short answer, restricted response and structured questions.

All assessments should be conducted under controlled, supervised conditions.

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

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

## **Unit specification: statement of standards**

**Unit title:** Process Analysers: On Line

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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 sampling systems as applied to on line analysers

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

- ◆ Sampling systems as applied to on line analysers for gases
- ◆ Sampling systems as applied to on line analysers for liquids
- ◆ Sampling systems as applied to on line analysers for solids
- ◆ Sampling systems as applied to on line analysers for multiphase

#### **Evidence Requirements**

Candidates will need evidence to demonstrate their knowledge and/or skills in this Outcome which 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 samples of the items above. In any assessment of this Outcome three out of four knowledge and/or skills items should be sampled. 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 systems as applied to on line analysers for gases
- ◆ explain systems as applied to on line analysers for liquids
- ◆ explain systems as applied to on line analysers for solids
- ◆ explain systems as applied to on line analysers for multiphase

#### **Assessment guidelines**

Evidence of candidate knowledge may take the form of a restricted response question, in which the candidate is given details of a typical industrial sampling situation e.g. type of liquid/gas or solid, flow rate, pressure and any special conditions (corrosive/non-corrosive, etc.) from which they have to select correctly an appropriate sampling system.

## SQA Advanced Unit Specification

The assessment paper for Outcome 1 can be a separate assessment lasting approximately one hour or can be combined with Outcomes 2, 3 and 4 should be taken at a single assessment event lasting approximately three hours. Such a paper should be composed of an appropriate balance of short answer, restricted response and structured questions.

Evidence should be generated through assessment undertaken in controlled supervised conditions. Assessments should be conducted under closed book conditions and as such candidates should not be allowed to bring any textbooks, handouts or non-programmable calculators to the assessment.

### Outcome 2

Explain the operation of on line electro-chemical type analysers

#### Knowledge and/or skills

- ◆ Basic construction of on line electro-chemical type analysers
- ◆ Principle of operation of on line electro-chemical type analysers
- ◆ Applications where on line electro-chemical type analysers would be used
- ◆ General maintenance procedures for on line electro-chemical type analysers

#### Evidence Requirements

Candidates will need evidence to demonstrate their knowledge and/or skills in this Outcome which 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 samples of the items above. In any assessment of this Outcome three out of four knowledge and/or skills items should be sampled. 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 the basic construction of on line electro-chemical type analysers
- ◆ explain the principle of operation of on line electro-chemical type analysers
- ◆ give applications for the use of on line electro-chemical type analysers
- ◆ explain the general maintenance procedures for on line electro-chemical type analysers

#### Assessment guidelines

The assessment paper for Outcome 2 can be a separate assessment lasting approximately one hour or can be combined with Outcomes 1, 3 and 4 should be taken at a single assessment event lasting approximately three hours. Such a paper should be composed of an appropriate balance of short answer, restricted response and structured questions.

Evidence should be generated through assessment undertaken in controlled supervised conditions. Assessments should be conducted under closed book conditions and as such candidates should not be allowed to bring any textbooks, handouts or non-programmable calculators to the assessment.

## **Outcome 3**

Explain the operation of on line inferential type analysers

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

- ◆ Basic construction of on line inferential type analysers
- ◆ Principle of operation of on line type inferential analysers
- ◆ Applications where on line inferential type analysers would be used
- ◆ General maintenance procedures for on line inferential type analysers

### **Evidence Requirements**

Candidates will need evidence to demonstrate their knowledge and/or skills in this Outcome which 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 samples of the items above. In any assessment of this Outcome three out of four knowledge and/or skills items should be sampled. 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 the basic construction of on line type inferential analysers
- ◆ explain the principle of operation of on line inferential type analysers
- ◆ give applications for the use of on line inferential type analysers
- ◆ explain the general maintenance procedures for on line inferential type analysers

### **Assessment guidelines**

The assessment paper for Outcome 3 can be a separate assessment lasting approximately one hour or can be combined with Outcomes 1, 2 and 4 should be taken at a single assessment event lasting approximately three hours. Such a paper should be composed of an appropriate balance of short answer, restricted response and structured questions.

Evidence should be generated through assessment undertaken in controlled supervised conditions. Assessments should be conducted under closed book conditions and as such candidates should not be allowed to bring any textbooks, handouts or non-programmable calculators to the assessment.

## **Outcome 4**

Explain the operation of on line electro-magnetic type analysers

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

- ◆ Basic construction of on line electro-magnetic radiation type analysers.
- ◆ Principle of operation of on line electro-magnetic radiation type analysers.
- ◆ Applications where on line electro-magnetic radiation type analysers would be used.
- ◆ General maintenance procedures for on line electro-magnetic radiation type analysers.

### **Evidence Requirements**

Candidates will need evidence to demonstrate their knowledge and/or skills in this Outcome which 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 samples of the items above. In any assessment of this Outcome three out of four knowledge and/or skills items should be sampled. 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 the basic construction of on line electro-magnetic radiation type analysers
- ◆ explain the principle of operation of on line electro- magnetic radiation type analysers
- ◆ give applications for the use of on line electro-magnetic radiation type analysers
- ◆ explain the general maintenance procedures for on line electro-magnetic radiation type analysers

### **Assessment guidelines**

The assessment paper for Outcome 4 can be a separate assessment lasting approximately one hour or can be combined with Outcomes 1, 2 and 3 should be taken at a single assessment event lasting approximately three hours. Such a paper should be composed of an appropriate balance of short answer, restricted response and structured questions.

Evidence should be generated through assessment undertaken in controlled supervised conditions. Assessments should be conducted under closed book conditions and as such candidates should not be allowed to bring any textbooks, handouts or non-programmable calculators to the assessment.

## SQA Advanced Unit Specification

### Administrative information

<b>Unit code:</b>	HV69 47
<b>Unit title:</b>	Process Analysers: On Line
<b>Superclass category:</b>	VE
<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: Process Analysers: On Line

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 sampling systems as applied to on line analysers.
- 2 Explain the operation of on line electro-chemical type analysers.
- 3 Explain the operation of on line inferential type analysers.
- 4 Explain the operation of on line electro-magnetic type analysers.

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 (7 hours)

Methods of obtaining representative samples, which may include ancillary equipment such as pumps, filters, coolers, scrubbers, trace heating or jacketing.

#### Outcome 2 (11 hours)

Electro-chemical type analysers. Analysers within this group make use of an electric signal resulting from a chemical change induced or occurring at the surface of electrodes immersed in a sample solution.

For example:

- ◆ Galvanic cells for gaseous or dissolved oxygen
- ◆ Polarographic cells for oxygen, hydrazine, halogens
- ◆ Fuel cells for hydrogen, hydrogen sulphide, oxides of nitrogen
- ◆ pH sensors specific to hydrogen ion activity but used as a measure of acidity or alkalinity
- ◆ Zirconia electrode for oxygen measurements of flue gas
- ◆ Conductivity



## SQA Advanced Unit Specification

### Outcome 3 (11 hours)

Inferential type analysers. For instruments within this group the composition is inferred by measuring some physical property of the process stream.

For example:

- ◆ Density: application of binary mixture of gases or miscible liquids, eg methanol-water, nitric acid-water; chromatography used
- ◆ Density measurement for liquid and gas phases, viscosity measurements
- ◆ Magnetic susceptibility: normally only oxygen is determined although oxides of nitrogen could be monitored
- ◆ Refractive index: measured by a deviation, differential or critical angle refractometer; applications: miscible liquids or solutions
- ◆ Dielectric constant: used mainly for measuring water in liquids or solids
- ◆ Thermal conductivity used for gas analysis
- ◆ Chromatography liquid and gas
- ◆ Hygrometry-moisture/Dew point
- ◆ Turbidity (optical clarity) and Silica content

### Outcome 4 (11 hours)

Electro-magnetic radiation type analysers. This diverse group depending upon absorption, emission, fluorescence or ionisation processes caused by electro-magnetic radiation ranging from X-rays through UV, visible, IR to microwaves.

For example:

- ◆ Infra-red absorption: used to detect most inorganic and organic gases and vapours, eg CO, CO<sub>2</sub>, CH<sub>4</sub>, H<sub>2</sub>O, NH<sub>3</sub>
- ◆ X-ray fluorescence (XRF): liquid, solid or gaseous samples may be measured when determining elements of atomic number above 10
- ◆ Microwave absorption: the attenuation of microwaves at about 10GHz in passing through the sample is measured, applications: water, in solids, liquids or gas

## Guidance on the delivery and assessment of this Unit

Due to the specialist equipment involved with on line analysers, it is recommended that site visits be used whenever possible to enhance the candidates experience and understanding of on line analysers.

The assessment for Outcomes 1, 2, 3 and 4 in this Unit can be assessed separately by a one hour assessment for each Outcome OR integrated into one end of Unit assessment paper lasting three hours. This paper should be taken by candidates at one single assessment event that should last three hours.

## **SQA Advanced Unit Specification**

### ***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 that may incorporate some degree of on line support and it would require planning by the centre to ensure the sufficiency and authenticity of candidate evidence. 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.

To keep the administrative burden to a minimum, it is recommended that a single end test is used for distance learning candidates.

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:** Process Analysers: On Line

This Unit has been designed to allow you to develop knowledge, understanding and skills associated with on line analysers used in process control.

The early part of the Unit deals with sampling systems and should provide you with a good knowledge in this subject area.

The Unit will also enable you to gain an understanding about three types of analysers commonly used in on line situations: they are electro-chemical, inferential and electro-magnetic radiation types. They all employ the use of a characteristic of the substance to be analysed. This enables the analysers to tell the user about the quantity of the substance that is being looked for in the sample being taken at that time. Hence on line analysers can be used to help control the process and give information to customers about the products make up.

The formal assessment for this Unit will most likely consist of one assessment. Outcomes 1, 2, 3 and 4 will be an integrated assessment paper that will last for approximately 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 assessment will normally be carried out at the end of the delivery of the Unit.