



## National Unit Specification: general information

**UNIT** Engineering: Measurement Technology – Flow (SCQF level 6)

**CODE** H0W6 12

### SUMMARY

This Unit can be delivered as part of a National Qualification Group Award but can also be taken as a free-standing Unit.

This Unit is designed to enable candidates to develop knowledge and understanding of positive and inferential flow measurement systems used in process industries. It will develop a knowledge and understanding of the physical relationships of flow measurement, the operation and characteristics of flow measurement systems, the installation and environmental factors and methods of compensating and correcting for factors that affect the accuracy of the flow measurement.

It will also develop knowledge and skills in checking the calibration of flow measurement systems.

This Unit is suitable for candidates studying the subject for the first time and acts as a basis for progression to employment and/or further study.

### OUTCOMES

- 1 Apply the key relationships of flow measurement.
- 2 Explain how accurate flow measurements are made.
- 3 Check and record calibration data of a positive and inferential flow measurement system.

### RECOMMENDED ENTRY

While entry is at the discretion of the centre, candidates would normally be expected to have attained one of the following, or equivalent:

- ◆ Standard Grade Mathematics — General/Credit Level
- ◆ Standard Grade Technological Studies and/or Science — General/Credit Level

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#### Administrative Information

**Superclass:** WD

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## **National Unit Specification: general information (cont)**

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### **CREDIT VALUE**

1 credit at SCQF level 6 (6 SCQF credit points at SCQF level 6\*).

*\*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 Access 1 to Doctorates*

### **CORE SKILLS**

There is no automatic certification of Core Skills in this Unit.

This Unit provides opportunities for candidates to develop aspects of the following Core Skills:

Numeracy            (SCQF level 6)

Problem Solving    (SCQF level 6)

These opportunities are highlighted in the Support Notes of this Unit Specification.

## **National Unit Specification: statement of standards**

### **UNIT        Engineering: Measurement Technology – Flow (SCQF level 6)**

Acceptable performance in this Unit will be the satisfactory achievement of the standards set out in this part of the Unit Specification. All sections of the statement of standards are mandatory and cannot be altered without reference to SQA.

#### **OUTCOME 1**

Apply the key relationships of flow measurement.

##### **Performance Criteria**

- (a) Units for the flow variable are correctly explained.
- (b) Flow states and physical parameters for the variable are correctly explained.
- (c) Physical relationships of fluid flow measurement are correctly applied.

#### **OUTCOME 2**

Explain how accurate flow measurements are made.

##### **Performance Criteria**

- (a) Construction and principle of operation of positive and inferential flow measurement systems are correctly explained.
- (b) Installation and environmental factors affecting flow measurement systems are correctly explained.
- (c) Methods of compensating and/or correction for installation and environmental factors are correctly explained.

#### **OUTCOME 3**

Check and record calibration data of a positive and inferential flow measurement system.

##### **Performance Criteria**

- (a) Calibration apparatus is correctly explained.
- (b) Calibration check is carried out in accordance with a given specification for a positive and inferential flow measurement system.
- (c) Reports containing relevant tables, graphs and characteristics for a positive and inferential flow measurement system are correctly produced.

## **National Unit Specification: statement of standards**

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### **EVIDENCE REQUIREMENTS FOR THIS UNIT**

Evidence is required to demonstrate that candidates have achieved all Outcomes and Performance Criteria.

Written and/or oral evidence is required which demonstrates that the candidate has achieved Outcome 1 and Outcome 2 to the standard specified in the Outcome and the Performance Criteria. The evidence for these Outcomes should be obtained under controlled, supervised conditions and include one positive and one inferential device. The assessment will be closed book and should last approximately 1 hour and 15 minutes.

Performance evidence, supplemented with an assessor observation checklist and written and/or oral evidence is required which demonstrates that the candidate has achieved Outcome 3 to the standard specified in the Outcome and Performance Criteria. Candidates are required to perform a calibration check of two flow measurement systems, one positive and one inferential. Evidence will be collected under controlled supervised conditions. The practical exercise should last approximately 1 hour.

The Assessment Support Pack for this Unit provides sample assessment material. Centres wishing to develop their own assessments should refer to the assessment support pack to ensure a comparable standard.

## National Unit Specification: support notes

### UNIT Engineering: Measurement Technology – Flow (SCQF level 6)

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 is a restricted core Unit within the National Certificate in Measurement and Control Engineering but is also suitable for candidates wishing to study the Unit on a free-standing basis.

This Unit aims to develop the candidate's knowledge and understanding of a range of positive and inferential flow measurement systems and should be delivered with the support of a measurement and control laboratory.

The range of topics that will be covered in the delivery of the Unit will be as follows:

#### Outcome 1

- ◆ System International (SI) units for velocity flow (m/s), volumetric flow ( $\text{m}^3/\text{s}$ ,  $\text{m}^3/\text{hr}$ , litres/s) and mass flow (kg/s, kg/hr)
- ◆ Velocity profiles for laminar and turbulent flow
- ◆ Continuity equation:  $Q = A_1v_1 = A_2v_2$
- ◆ Reynolds number  $R_E = (\rho \cdot d \cdot v) / \eta$
- ◆ Bernoulli's equation  $P_1/\rho + v_1^2/2 + gh_1 = P_2/\rho + v_2^2/2 + gh_2 \pm \text{losses (J/kg)}$
- ◆ Coefficient of discharge = actual flow/theoretical flow
- ◆ Viscosity (Pa.s)
- ◆ Fluid density ( $\text{kg}/\text{m}^3$ )
- ◆ Temperature effects

#### Outcome 2

- ◆ Differential pressure generating devices (orifice plate, Venturi tube, nozzle)
- ◆ Turbine meter (mechanical and impulse types)
- ◆ Variable area flowmeter
- ◆ Electromagnetic flowmeter
- ◆ Ultrasonic flowmeter
- ◆ Target flowmeter
- ◆ Vortex flowmeter
- ◆ Coriolis flowmeter
- ◆ Thermal mass flowmeter
- ◆ Positive displacement flowmeters for liquid and gas flows
- ◆ Installation factors:
  - location of flowmeter in pipe
  - orifice tapings
  - causes and effects of trapped air in a liquid flow
  - causes and effects of trapped liquid in a gas flow
  - pressure drops and the effects of cavitation

## National Unit Specification: support notes (cont)

### UNIT      Engineering: Measurement Technology – Flow (SCQF level 6)

- ◆ Environmental factors:
  - noise
  - density changes
  - dirt in pipe
  - condensate forming in gas flows
  - temperature effects
  - electromagnetic fields
- ◆ Correction/compensation methods for installation/environmental factors:
  - flow straighteners
  - drains and vents
  - back-pressure valve to minimise pressure drops and cavitation
  - filters

#### Outcome 3

- ◆ Volumetric methods of calibration
- ◆ Gravimetric methods of calibration
- ◆ Master meter

#### GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

In this Unit the Outcomes should be delivered in order.

The use of ICT (Information and Communication Technology) should be used to support the delivery of this Unit. This could take the form of candidates researching different types of flow measurement equipment on the internet.

This Unit requires access to a measurement and control engineering laboratory with a range of flow measurement devices/equipment. Demonstrations and laboratory exercises can be used to improve the candidate's understanding of flow measurement which will help to relate theory to practice.

#### OPPORTUNITIES FOR CORE SKILL DEVELOPMENT

Candidates have to consider and explain a number of complex numerical and graphic concepts in situations where the relevance and significance of information needs to be understood and applied. The ability to perform, interpret and record accurate flow measurements and calibrations would be enhanced by formative opportunities to practise calculations in practical engineering contexts.

All elements of the Core Skill of *Problem Solving*, that is, planning and organising, critical thinking, and reviewing and evaluating, will be naturally developed as candidates apply knowledge and understanding to a complex practical task. The characteristics of flow measurement systems and their effects will be fully analysed. The influence of installation and environmental factors will be taken into account before calibration data is measured, checked and recorded. Evaluation will be on going although class group discussion and assessor feedback may be useful to candidates as they analyse issues in depth at various stages of formative activity.

## **National Unit Specification: support notes (cont)**

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### **GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT**

#### **Opportunities for the use of e-assessment**

E-assessment may be appropriate for some assessments in this Unit. By e-assessment we mean assessment which is supported by information and communications technology (ICT), such as e-testing or the use of e-portfolios or e-checklists. Centres which wish to use e-assessment must ensure that the national standard is applied to all candidate evidence and that conditions of assessment as specified in the Evidence Requirements are met, regardless of the mode of gathering evidence. Further advice is available in *SQA Guidelines on Online Assessment for Further Education (AA1641, March 2003)*, *SQA Guidelines on e-assessment for Schools (BD2625, June 2005)*.

Achievement of this Unit requires the Evidence Requirements for each Outcome to be met. A candidate who does not initially achieve the specified standard can have a further opportunity, attempting only the Outcome(s) not previously achieved.

Outcome 1 and Outcome 2 could be integrated into a single assessment and could be assessed by a 1 hour and 15 minute closed book test which could consist of a series of short answer, restricted response and structured questions. Questions should test the candidate's knowledge of the physical science principles and their application to the principle of operation of flow measurement devices. Candidates can have access to course materials and relevant textbooks. This assessment can be taken after the completion of the delivery of Outcome 1 and Outcome 2.

Outcome 3 could be assessed by a practical exercise that involves a calibration check of two flow measurement systems (one positive and one inferential). An observation checklist should be used to record candidate performance and should last no longer than 1 hour. The assessment also requires the production of a suitable brief report for each measurement system. Each report should include the calibration data and its interpretation.

This practical assessment should be carried out towards the end of the Unit.

#### **CANDIDATES WITH DISABILITIES AND/OR ADDITIONAL SUPPORT NEEDS**

The additional support needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments, or considering alternative Outcomes for Units. Further advice can be found in the SQA document *Guidance on Assessment Arrangements for Candidates with Disabilities and/or Additional Support Needs (www.sqa.org.uk)*.