



## National Unit Specification: general information

**UNIT** Engineering: Measurement Technology – Pressure/Level  
(SCQF level 6)

**CODE** F5KT 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 pressure and level measurement systems used in industry.

It will develop a knowledge and understanding of the physical relationships of pressure and level measurement, the operation and characteristics of pressure measurement systems and level measurement systems, the installation and environmental factors and methods of compensating and correcting for factors that affect the accuracy of the pressure measurement and level measurement. It will also develop knowledge and skills in checking the calibration of pressure measurement and level 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 pressure measurement and level measurement.
- 2 Explain how accurate pressure measurement and level measurements are made.
- 3 Check and record the calibration of pressure measurement and level measurement systems.

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#### Administrative Information

**Superclass:** WD

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## National Unit Specification: general information (cont)

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### 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 in Mathematics — General/Credit Level
- ◆ Standard Grade Technological Studies/Science subjects — General/Credit Level

### 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:

Problem Solving            (SCQF level 6)  
Numeracy                    (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 – Pressure/Level (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 pressure measurement and level measurement.

##### **Performance Criteria**

- (a) Units for the pressure variable and the level variable are correctly explained.
- (b) Physical parameters for the variables are correctly explained.
- (c) Physical relationships of pressure measurement and level measurement are correctly applied.

#### **OUTCOME 2**

Explain how accurate pressure measurement and level measurements are made.

##### **Performance Criteria**

- (a) Construction and principle of operation of pressure measurement devices and level measurement devices are correctly explained.
- (b) Installation and environmental factors affecting pressure measurement devices and level measurement devices are correctly explained.
- (c) Methods of compensating and/or correction for installation and environmental factors are correctly explained.

#### **OUTCOME 3**

Check and record the calibration of pressure measurement and level measurement systems.

##### **Performance Criteria**

- (a) Calibration apparatus is correctly explained.
- (b) Calibration check is carried out in accordance with a given specification for pressure measurement and level measurement systems.
- (c) Reports for pressure measurement and level measurement systems 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.

The assessment will be closed-book and should last approximately 1 hour.

Performance evidence 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 the Performance Criteria. Outcome 3 should be assessed by a practical exercise that involves a calibration check of two measurement systems (one flow and one level). Candidates can have access to notes, reference books and manufacturer's data sheets for this assessment. An observation checklist should be used to record the candidate's achievement in the practical work. The assessment for this Outcome should take place towards the end of this Unit.

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 – Pressure/Level (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 can also be delivered on a free-standing basis.

Safety regulations and safe working practices and procedures should be observed at all times.

This Unit aims to develop the candidates knowledge and understanding of a range of pressure measurement and level 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

Units — pressure:  $\text{N/m}^2$  (Pa), bar, mbar, psi, mm/cm/m/inches water gauge, (absolute and gauge).

Units — level: mm/cm/m/inches/feet, percentage.

Pressure equals force/area or head of liquid ( $P = \rho.g.h$ ), types of pressure (gauge, vacuum, absolute, atmospheric and differential). Absolute density and relative density. Level in terms of depth and density. Archimedes principle. Density =  $\text{kg/m}^3$  gravitational acceleration =  $9.81\text{m/s}^2$ .

Material stress and strain, Modulus of Elasticity, Hookes Law and stress and strain characteristic.

Ultrasonic/radar (frequency ranges), nucleonics, capacitance and radioactive principles.

#### Outcome 2

Manometers. Pressure gauges: Bourdon tube and diaphragm types, construction, installation factors and calibration. Standard gauges and safety gauge construction and installation.

Applications (no oil on oxygen/acetylene service).

Force-balance transmitters: gauge pressure and differential pressure devices.

(pneumatic/electronic/smart).

Transmitter 4-20mA/0.2-1Bar outputs. HART communications.

Capacitance type cell: installation and maintenance checks. Bellows mechanisms, use and installation.

Float/displacer mechanisms. Hydrostatic head methods: Open and closed tanks, effect of density changes on the measurement.

Purge tube, single and twin tube methods, Pneumercators/pneumerstat.

Capacitance probe method: sensing and bridge frequency of operation.

Level switches: float, optical, ultrasonic (tuning fork), nucleonic, and conductivity methods.

Ultrasonic and radar level measurement methods, nucleonic level measurement methods.

Detection of interface.

Smart transmitter for pressure and level measurements.

## National Unit Specification: support notes (cont)

### UNIT            Engineering: Measurement Technology – Pressure/Level (SCQF level 6)

Telemetry (HART communication) between smart transmitters hand held pendants and lap top computers.

Factors affecting measurement devices such as ambient temperature and pressure variations, head effects due to position, pulsating pump flows, density changes.

#### Outcome 3

Compiling graphs of calibration results and identifying errors.

Calibration of Bourdon gauges and standard gauges.

Calibration of gauge and differential pressure devices.

Calibration of pressure transmitters using smart and non-smart devices.

Use of dead weight testers and comparison methods. Druck pressure calibrators. Calibration certificates.

Calibration of ultrasonic, radar, nucleonic, capacitance, and hydrostatic head methods of level measurement using smart and non-smart transmitters.

#### 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 pressure and level measurement equipment on the internet.

This Unit requires access to a measurement and control engineering laboratory with a range of pressure and level measurement devices and calibration equipment. Demonstrations and laboratory exercises can be used to improve the candidates understanding of pressure and level measurement systems which will help to relate theory to practice.

#### OPPORTUNITIES FOR CORE SKILL DEVELOPMENT

Elements of the Core Skill of *Problem Solving*, that is, critical thinking, planning and organising and reviewing and evaluating, will be naturally developed and enhanced as candidates apply knowledge of the physical science principles to the operation of pressure and level measurement devices.

Identifying and analysing a complex range of relevant factors will include consideration of ambient temperature and pressure variations, head effects due to position, and density changes. Candidates must then work efficiently and safely to complete practical measurements. Discussing, practising and evaluating the process in a laboratory environment will be routine in formative work.

Candidates perform, interpret and present a series of complex calculations and measurements as they complete calibration checks on two measurement systems. *Numeracy* skills will be naturally enhanced, with the focus on practical interpretation and application of data. Formative practical activities should be designed to develop accuracy and confidence in handling graphic and numerical concepts in an engineering context.

## 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 assessed by a 1 hour 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 pressure and level measurement devices. This assessment can be taken after the completion of the delivery of Outcome 1 and Outcome 2.

Outcome 3 should be assessed by a practical exercise that involves a calibration check of two measurement systems (one flow and one level). An observation checklist should be used to record candidate performance. 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](http://www.sqa.org.uk)).