



National Unit Specification: general information

UNIT Engineering: Measurement Technology – Temperature
(SCQF level 6)

CODE F5KS 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 temperature measurement systems used in process industries. It will develop a knowledge and understanding of the physical relationships of temperature measurement, the operation and characteristics of temperature measurement systems, the installation and environmental factors and methods of compensating and correcting for factors that affect the accuracy of the temperature measurement.

It will also develop knowledge and skills in checking the calibration of temperature 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 temperature measurement.
- 2 Explain how accurate temperature measurements are made.
- 3 Check and record calibration data of temperature measurement systems.

Administrative Information

Superclass: WD

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

CREDIT VALUE

1 credit at SCQF level (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

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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 temperature measurement.

Performance Criteria

- (a) Units and International Practical Temperature Scale (IPTS) for the temperature variable are correctly explained.
- (b) Fixed points on the IPTS are correctly explained.
- (c) Physical relationships of temperature measurement are correctly applied.

OUTCOME 2

Explain how accurate temperature measurements are made.

Performance Criteria

- (a) Construction and principle of operation of temperature measurement systems are correctly explained.
- (b) Installation and environmental factors affecting temperature measurement systems are correctly explained.

OUTCOME 3

Check and record calibration data of temperature measurement systems.

Performance Criteria

- (a) Calibration apparatus is correctly explained.
- (b) Calibration checks are carried out in accordance with a given specification for temperature measurement systems.
- (c) Reports containing relevant tables, graphs and characteristics of temperature measurement systems are correctly produced.

National Unit Specification: statement of standards (cont)

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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 Outcomes 1 and 2 to the standard specified in the Outcomes and Performance Criteria.

The evidence for Outcome 1 and Outcome 2 should be obtained in a combined assessment carried out under controlled, supervised conditions. The assessment will be closed-book and should last approximately 1 hour.

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. The evidence for this Outcome should be obtained under controlled, supervised conditions with the candidates having access to notes and reference books. Candidates are required to carry out a calibration check of two temperature measurement systems. This practical activity should take place at the end of the Unit and should last approximately 1 hour.

Assessor observation/checklists must record the correct set up and operation of the calibration equipment and will be retained by the centre.

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

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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.

Outcome 1 should be used as an introduction to the concepts underpinning the rest of the Unit.

The temperature scales covered should include Celsius, Kelvin and Fahrenheit and the relationship between them, fundamental interval. IPTS fixed points of temperature, definitions of boiling point, freezing point. Triple point of water.

The Pressure Law, Charles' Law, Boyle's Law and the Combined Gas Equation.

The resistance/temperature relationship $R_T = R_0(1 + \alpha T)$.

Electromagnetic spectrum. Relationship between temperature and thermal radiation $P = \sigma \cdot E \cdot T^4$ (W/m^2), Stefan Boltzmann constant, black body conditions and emissivity. Thermoelectric phenomena, the Seebeck effect and the laws of intermediate temperatures and metals. Peltier effect.

Outcome 2 should develop the concepts of Outcome 1 and apply them to practical industrial temperature measurement systems.

For each of the measurement systems covered candidates should learn the principles of operation, the installation requirements and the environmental factors requiring correction.

The construction and principle of operation of a range of industrial temperature measurement systems must be explained. One installation and one environmental factor must be identified for each measurement device.

Suitable devices should include; liquid in glass thermometer, bimetallic thermometers, filled system thermometers, resistance thermometers PT100, 3/4 wire bridge arrangements and the PT100 with head mounted transmitter, thermocouples — J,K,R,S and T types and thermocouples with a head mounted transmitter, optical and radiation pyrometers and thermistors for ambient temperature sensing.

National Unit Specification: support notes (cont)

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Outcome 3 enables the candidate to gain practical experience of the operation and calibration check of two temperature measuring devices and systems covered in Outcome 2.

Calibration checks must be carried out for two different temperature measurement systems and associated data produced.

Calibration equipment to include — water baths, sand baths, dry block calibrator, freezing point furnace, tube furnace and multi-function calibrators.

Candidates should be aware of the health and safety issues when using the calibration equipment.

Results should be obtained and displayed in both tabular and graphical forms. Candidates should be encouraged to interpret the results and draw their own conclusions regarding the calibration of the system.

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 temperature measurement systems/equipment on the internet.

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

OPPORTUNITIES FOR CORE SKILL DEVELOPMENT

Candidates have to consider and explain a number of complex numerical and graphical concepts in situations where the relevance and significance of information needs to be understood and applied. The ability to perform, interpret and record accurate measurements and calibrations would be enhanced by formative opportunities to practice 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 physical science principles to the complex practical task in Outcome 3. Device operating characteristics are fully investigated, and safety and environmental factors taken into account before results are interpreted, evaluated and written up. Class group discussion and assessor feedback may be useful to candidates as they analyse and evaluate issues at the 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)*.

Outcome 1 and Outcome 2 could be integrated into a single assessment and could be assessed by a 1 hour closed-book test which could consist of a series of short answer, restricted response and structured questions, part completed diagrams can be provided. Questions should test the candidate's knowledge of the physical science principles and their application to the principle of operation of temperature measurement devices. 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 temperature measurement systems. 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)*.

National Unit Specification: support notes (cont)

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History of changes:

Version	Description of change	Date
02	Amendment to evidence requirements regarding outcome 3. Now 'two' temperature measuring systems instead of 'three'.	01/03/2012