



## Higher National Unit Specification

### General information

**Unit title:** Safe Hydrogen Gas Handling (SCQF level 6)

**Unit code:** J5SJ 33

**Superclass:** YB

**Publication date:** October 2021

**Source:** Scottish Qualifications Authority

**Version:** 02, December 2021

### Unit purpose

The purpose of this unit is to introduce learners to the basic properties of hydrogen as a fuel source and energy carrier; the industrial regulations applicable to the industry; the safety risks associated with hydrogen gas; and the correct procedures for hydrogen gas handling.

This unit has been developed as part of the PDA in Hydrogen: An Introduction for Technicians however it is also available as a freestanding unit.

### Outcomes

On successful completion of the unit the learner will be able to:

- 1 Describe the properties of hydrogen as a fuel source or energy carrier.
- 2 Explain with legislation and regulations relating to hydrogen gas handling and safety.
- 3 Identify safety risks associated with hydrogen.
- 4 Perform generic procedures for correctly handling hydrogen cylinders.

### Credit points and level

1 Higher National Unit credit at SCQF level 6: (8 SCQF credit points at SCQF level 6)

## **Higher National Unit Specification: General information (cont)**

**Unit title:** Safe Hydrogen Gas Handling (SCQF level 6)

### **Recommended entry to the unit**

Access to this unit is at the discretion of the centre. However, it would be advantageous for learners to have completed, or be studying towards, qualifications that develop core engineering design and analysis skills. These could include, but are not limited to, NC or HNC qualifications in: Electrical Engineering, Mechanical Engineering, Engineering Systems, Manufacturing Engineering or Measurement and Control Engineering.

Additionally, learners will benefit from having attained Higher level education in STEM subjects such as Maths and Science or SVQ in engineering disciplines such as Mechanical, Manufacturing or Electrical Engineering.

Learners with suitable relevant industrial experience or qualifications may also be considered.

### **Core Skills**

Opportunities to develop aspects of Core Skills are highlighted in the support notes for this unit specification.

There is no automatic certification of Core Skills or Core Skill components in this unit.

### **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.

### **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).

## Higher National Unit Specification: Statement of standards

### Unit title: Safe Hydrogen Gas Handling (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.

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. Learners 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

Describe the properties of hydrogen as a fuel source or energy carrier.

##### Knowledge and/or skills

- ◆ Properties of hydrogen gas
- ◆ Basic energy and conversion calculations relating to hydrogen
- ◆ The operation of an electrolyser and fuel cell
- ◆ Reformed hydrogen and 'green' hydrogen
- ◆ Knowledge of hydrogen storage methods

#### Outcome 2

Explain with legislation and regulations relating to hydrogen gas handling and safety.

##### Knowledge and/or skills

- ◆ The specific regulations applicable to the hydrogen industry
- ◆ Recognise why regulation is needed
- ◆ Understand the situations in which different regulations apply

#### Outcome 3

Identify safety risks associated with hydrogen.

##### Knowledge and/or skills

- ◆ Knowledge of how to conduct a standard risk assessment
- ◆ Be aware of issues of pressure and flammability
- ◆ A comparison is made with other gases and distinctions made
- ◆ Testing for leaks, using a fume cupboard when necessary
- ◆ Recognise the requirement for correct protective equipment

## **Higher National Unit Specification: Statement of standards (cont)**

**Unit title:** Safe Hydrogen Gas Handling (SCQF level 6)

### **Outcome 4**

Perform generic procedures for correctly handling hydrogen cylinders.

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

- ◆ Identifying and handling cylinders
- ◆ Loading and unloading trailers
- ◆ Storing cylinders
- ◆ Selection and use of regulators

## Higher National Unit Specification: Statement of standards (cont)

**Unit title:** Safe Hydrogen Gas Handling (SCQF level 6)

### Evidence requirements for this unit

#### Outcome 1

Learners will need to provide written and/or oral recorded evidence to demonstrate they can examine two of the five knowledge and/or skills items.

- (a) The learner will understand the basic properties of hydrogen gas, eg: density, chemical activity, flammability, response when pressurised, buoyancy in the atmosphere, and free flow speed.
- (b) The learner will understand the energy released when burnt in air, and the difference between higher heating value and lower heating value.
- (c) The learner will understand how green hydrogen is produced by electrolysis and can be directly burnt or converted back to electricity using a fuel cell. An overview of the basic operating principles of a fuel cell and electrolyser and typical efficiencies is provided.
- (d) The learner will understand the reforming process where hydrogen is produced from natural gas and the chemical processes involved.
- (e) The learner will understand how hydrogen is stored at low pressure, high pressure, liquid form and using hydrides.

Evidence for the knowledge and/or skills in this outcome will be generated under supervised open-book, timed conditions.

#### Outcome 2

Learners will need to provide written and/or oral recorded evidence to demonstrate they can examine two of the three knowledge and/or skills items.

- (a) The learner will be aware of applicable requirements drawn from key industry regulations including (but not limited to):
  - ◆ ATEX (EU directives pertaining to EXplosive ATmospheres)
  - ◆ PED (Pressure Equipment Directive)
  - ◆ COSHH (Control of Substances Hazardous to Health)
  - ◆ Manual Handling
  - ◆ BCGA (British Compressed Gas Association) Code of Practice
  - ◆ HSE (Health and Safety Executive) Installation Guidance
  - ◆ BSI (British Standards Institution) sector relevant standards
  - ◆ PSSR (Pressure System Safety Regulations)
  - ◆ COMAH (Control of Major Accident Hazards)
  - ◆ RIDDOR (Reporting of Injuries, Diseases and Dangerous Occurrences Regulations)
- (b) The learner will be aware of how regulations vary across the world.
- (c) The learner will learn the importance of record keeping (and best practice in doing so) to demonstrate compliance with applicable regulatory requirements.

Evidence for the knowledge and/or skills in this outcome will be generated under supervised open-book conditions, timed conditions.

## Higher National Unit Specification: Statement of standards (cont)

**Unit title:** Safe Hydrogen Gas Handling (SCQF level 6)

### Outcome 3

Learners will need to provide product evidence to demonstrate their knowledge and/or skills by showing that they can:

- (a) The learner will understand the need for a risk assessment and the standard procedures to follow. The learner should be encouraged to take a proactive approach to risk assessment.
- (b) The learner will identify asphyxia, flammability and explosion hazards, and the mitigation measures.
- (c) The learner will understand the additional risk when there is bottled oxygen present and is able to distinguish how the procedures change when working with gases such as LNG, propane, acetylene, and how nitrogen can be used to purge pipelines.
- (d) The learner will be able to follow the procedure for testing for leaks, the equipment needed, and how the tests can be safely conducted. The procedure to follow in the event of a leak being detected will be clearly understood.
- (e) Learners will understand possible hazards and the impact on procedures such as welding and cutting. The correct personal protective equipment to be used in each situation is clearly identified.

Evidence for the knowledge and/or skills in this outcome will be generated under open-book, unseen conditions.

### Outcome 4

Learners will need to provide product evidence to demonstrate their knowledge and/or skills by showing that they can:

- (a) The learner will understand how cylinders operate and become familiar with different sizes of hydrogen cylinder and the typical weight, empty and full. The learner will recognise labels, colour-coding, and types of fittings, and will learn how to correctly distinguish hydrogen gas products based on these identifiers.
- (b) The learner will be aware of how hydrogen cylinders are handled moved, and safely secured and stored. The learner will learn to be aware of the hazards associated with manual handling.
- (c) The learner will understand how to identify and select the appropriate regulator for specific hydrogen gas cylinders. The learner will also learn how to correctly fit each form of regulator.

Evidence for the knowledge and/or skills in this outcome will be generated under open-book, unseen conditions.



## Higher National Unit Support Notes

**Unit title:** Safe Hydrogen Gas Handling (SCQF level 6)

Unit support notes are offered as guidance and 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 developed to provide learners with fundamental knowledge and skills appropriate to working in the hydrogen gas industry. It is designed to instil in learners both the necessary knowledge and practical experience required of a competent technician-level operator.

- ◆ In Outcome 1, learners are introduced to the principles of using hydrogen gas as a source of fuel. There is no requirement to derive the properties from thermodynamic principles. Having knowledge of the properties of hydrogen gas and an understanding of the essential energy calculations will enable learners to better understand the industry as a whole and will provide them with the opportunity to develop their skills (through further study) into technical roles such as design and operation of plant.
- ◆ In Outcome 2, learners are exposed to the essential regulatory requirements applicable to the industry. Knowledge of such regulations, their specific requirements, and the scenarios in which each set of requirements is applied is essential to ensure the safe working practices of learners who go on to work in a hydrogen industry environment.
- ◆ In Outcome 3, learners are taught the fundamentals of the risk assessment process along with risks specific to the hydrogen industry environment. Understanding the importance of working in a risk managed environment and having the skills to undertake a risk assessment is again, essential to ensure the safe working practices of learners who go on to work in a hydrogen industry environment. Skills are further enshrined by exposing learners to examples of the specific risks that they may come across in the hydrogen industry.
- ◆ In Outcome 4, learners are provided with practical experience of correct manual handling procedures to ensure that they have the skills necessary to work with, move and store hydrogen products. This skillset will reduce the likelihood of personal injury and, by following standardised industry best practices, will also lead to the creation of a working environment that is safe for both the learner and their fellow employees.

### Guidance on approaches to delivery of this unit

It is anticipated that a sequential approach to delivery should be taken, where learners gain fundamental knowledge by studying and completing Outcomes 1 and 2, before moving onto learning the practical skills contained in Outcomes 3 and 4.

## Higher National Unit Support Notes (cont)

### Unit title: Safe Hydrogen Gas Handling (SCQF level 6)

Outcomes 1 and 2 shall principally be delivered in a classroom or virtual learning environment. Outcomes 3 and 4 shall be delivered either in an industrial setting (with risk assessment and handling procedures being demonstrated on real hydrogen plant) or in an emulated environment created in an academic institution laboratory. Note that it is expected that the emulated environment offers access to some industrial equipment, eg, cylinders, signage, PPE equipment, etc, such that learners are exposed to training in the necessary the practical skills.

- ◆ The learner should have hazards shown to them either in an industrial environment or in a video or in a sequence of still images.
- ◆ The learner should be guided through an appropriate industrial procedure for identifying hazards in the industrial work environment by a suitably qualified and experienced person.
- ◆ The learner should be shown appropriate Personal Protective Equipment (PPE) for working in the various environments of a typical UK hydrogen facility.
- ◆ The learner should have access to appropriate equipment, eg, cylinders (unfilled), regulators, identification signs and symbols, for demonstration purposes and to allow students to practice manual handling.

The information pertaining to each outcome could be delivered through a mix of knowledge delivery and video clips and is suitable for remote delivery. Online material such as the SGN Hydrogen Awareness course may offer an ideal introduction.

The exact distribution of time between outcomes is at the discretion of the centre, however, the expected time requirements for each outcome and supervised assessments (Outcome 1 and 2) are as follows:

- ◆ Outcome 1 — 15 hours
- ◆ Outcome 2 — 12 hours
- ◆ Outcome 3 — 8 hours
- ◆ Outcome 4 — 5 hours

### Guidance on approaches to assessment of this unit

Evidence can be generated using different types of assessment. The following are suggestions only. There may be other methods that would be more suitable to learners.

Centres are reminded that prior verification of centre-devised assessments would help to ensure that the national standard is being met. Where learners experience a range of assessment methods, this helps them to develop different skills that should be transferable to work or further and higher education.

- ◆ Outcome 1 could be assessed through one extended (multi-part) calculation exercise. Learners shall be expected to complete the exercise in an open-book, supervised and timed examination environment. The duration of this exercise should not exceed one hour.



## Higher National Unit Support Notes (cont)

### Unit title: Safe Hydrogen Gas Handling (SCQF level 6)

- ◆ Outcome 2 could be assessed through a 20-question multiple choice quiz (four options per question) or by three extended response questions. Learners shall be expected to complete the exercise in an open-book, supervised and timed examination environment. The duration of this exercise should not exceed one hour.
- ◆ Outcome 3 involves practical exercises and could be assessed by the use of observation checklists and the submission of a short report detailing potential hazards, necessary PPE, and risk assessment procedures to ensure safety when working with hydrogen in a particular complex industrial environment. The report may be conducted outside of the learning environment ie, in unseen and open-book assessment conditions. The report shall be assessed by a suitably qualified and experienced person (either in industry or academia), who shall determine whether the learner has demonstrated in their report that they have an adequate understanding of hazard awareness and safe working practices.
- ◆ Outcome 4 involves practical exercises and could be assessed by the use of observation checklists and the submission of a short report outlining the correct manual handling procedure and identifying the appropriate use of select regulators that the learner has practiced. The report may be conducted outside of the learning environment ie, in unseen and open-book assessment conditions. The report shall be assessed by a suitably qualified and experienced person (either in industry or academia), who shall determine whether the student has demonstrated in their report that they have an adequate understanding of generic manual handling procedures. It should be noted that this evidence will demonstrate practical experience specific to the equipment available to the assessment centre though additional training will be required for specific items of equipment that learners encounter in their future career.

### Opportunities for 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 Communication Technology (ICT), such as e-testing or the use of e-portfolios or social software. Centres which wish to use e-assessment must ensure that the national standard is applied to all learner evidence and that conditions of assessment as specified in the evidence requirements are met, regardless of the mode of gathering evidence. The most up-to-date guidance on the use of e-assessment to support SQA's qualifications is available at [www.sqa.org.uk/e-assessment](http://www.sqa.org.uk/e-assessment).

## Higher National Unit Support Notes (cont)

**Unit title:** Safe Hydrogen Gas Handling (SCQF level 6)

### Opportunities for developing Core and other essential skills

There are opportunities to develop the following Core Skills in this unit.

*Communication*, at SCQF level 5, can be developed in learners across all outcomes of this unit. In Outcome 1, learners will be exposed to written learning materials and will be expected to discern relevant information. In Outcome 2, learners will have to read and discuss relevant legislation and regulatory codes and produce written evidence of an understanding of the requirements in a clear and concise manner. Oral communication skills will be developed principally in Outcomes 3 and 4, in which learners are exposed to practical skills in an industrial (or emulated) environment. Students will be expected to learn by verbal instruction (supported by a demonstration where appropriate) and will have the opportunity to interact with instructors and fellow learners by questioning instructions or sharing understandings.

*Numeracy*, at SCQF level 5, can be developed by learners carrying out the basic energy conversion calculations contained in Outcome 1.

Information and Communication Technology component *Accessing Information* can be developed by learners at SCQF level 5, by using the internet to access resources.

Problem Solving components *Critical Thinking* and *Reviewing and Evaluating*, at SCQF level 5, across all outcomes of this unit. In Outcome 1, learners will be exposed to mathematical problems such as basic energy conversion calculations. In Outcome 2, learners will be introduced to the relevant industrial standards and regulations and will be expected to learn how to discern which requirements are application to particular scenarios and environments. Outcome 3 will introduce learners to risk assessment practices, in which personnel are expected to flexibly evaluate an environment to ensure safe working practices.

*Working with Others*, at SCQF level 5, can be developed by using group work within the classroom, industrial and laboratory settings, which allows learners to share experiences with their fellow learners. Groups will be encouraged to collaborate to get the most out of their learning experience and to bring forth best practices and understandings to the benefit of all.

## History of changes to unit

Version	Description of change	Date
02	Minor amends to outcomes 1, 3 and 4.	09/12/21

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## General information for learners

### Unit title: Safe Hydrogen Gas Handling (SCQF level 6)

This section will help you decide whether this is the unit for you by explaining what the unit is about, what you should know or be able to do before you start, what you will need to do during the unit and opportunities for further learning and employment.

Following detailed analysis of current and anticipated hydrogen activity in Scotland and Europe, it was concluded that there is reasonable expectation of hydrogen technologies making a significant contribution to the Scottish economy over the next 10 years.

In order to develop the skills required to meet the skill gap in the hydrogen sector, this unit shall educate learners in the basic properties of hydrogen as a fuel source; in the industrial regulations applicable to the industry; in safety risks associated with hydrogen gas; and in the correct procedures for hydrogen gas handling.

The aim of this unit is to provide you with fundamental knowledge and skills appropriate to working in the hydrogen gas industry. In addition, in completing this unit you will have the opportunity to develop Core Skills and components of core skills at SCQF level 5.

This unit has been developed as part of the PDA in Hydrogen: An Introduction for Technicians, however, is also available as a freestanding unit. The PDA in Hydrogen: An Introduction for Technicians is a three-unit course that offers an industry and SQA recognised certification demonstrating technician-level training in hydrogen technologies and provides learners with the opportunity to develop current and future skills to meet the needs of industry. The other two units in the PDA are: *Operating Principles of a Hydrogen Facility* at SCQF level 7 and *Design Principles of a Hydrogen System* at SCQF level 8.

- ◆ In Outcome 1, you will be introduced to the principles of using hydrogen gas as a source of fuel. Having knowledge of the properties of hydrogen gas and an understanding of the essential energy calculations will enable you to better understand the industry as a whole and will provide you with the opportunity to develop your skills (through further study) into technical roles such as design and operation of plant.
- ◆ In Outcome 2, you will be introduced to the essential regulatory requirements applicable to the industry. Knowledge of such regulations, their specific requirements, and the scenarios in which each set of requirements is applied is essential to ensure the safe working practices of learners who go on to work in a hydrogen industry environment.
- ◆ In Outcome 3, you shall be taught the fundamentals of the risk assessment process along with risks specific to the hydrogen industry environment. Understanding the importance of working in a risk managed environment and having the skills to undertake a risk assessment is again, essential to ensure the safe working practices of learners who go on to work in a hydrogen industry environment. Your skills shall be further enshrined by exploring examples of the specific risks that they may come across in the hydrogen industry.
- ◆ In Outcome 4, you shall be provided with practical experience of correct manual handling procedures to ensure that you have the skills necessary to work with, move and store hydrogen products. This skillset will reduce the likelihood of personal injury and, by following standardised industry best practices, will also lead to the creation of a working environment that is safe for both yourself and your future fellow employees.

## **General information for learners (cont)**

**Unit title:** Safe Hydrogen Gas Handling (SCQF level 6)

On successful completion of the unit, you will be able to:

- 1 Describe the properties of hydrogen as a fuel source.
- 2 Explain with legislation and regulations relating to hydrogen gas handling and safety.
- 3 Identify safety risks associated with hydrogen.
- 4 Perform generic procedures for correctly handling hydrogen cylinders.

Outcomes 1 and 2 of this unit will be assessed by written and/or recorded oral evidence in a supervised, open-book and timed assessment environment. For Outcomes 3 and 4, you will provide product evidence generated under open-book, unseen conditions.