

Hy4Heat Competence Framework

Hydrogen Transition Training Specification

(To support 100% Hydrogen Community Trials)

SECTION 1: INTRODUCTION AND CONTEXT

1 INTRODUCTION

1.1 This Hydrogen Pathway Training Specification relates to:

Existing Gas Safe Registered (GSR) engineers who will be carrying out installation, commissioning, handover, and maintenance work, including potential manufacturer modifications as necessary, on appliances fuelled by **100%** hydrogen gas.

The Training Specification is designed to enable approved Training Providers to develop a hydrogen course for approval under the IGEM/IG/1 Standard for Training in Gas Work.

Reference is made throughout this Specification to the Hydrogen Interim Standard [IGEM/H/2]. It should be noted that this Standard is subject to future revision and amendment, as additional information relating to the use of hydrogen becomes available. **Providers must ensure that any training courses developed in line with this Specification maintain alignment with the latest edition of IGEM/H/2 before being offered to learners.**

1.2 The initial use of this Specification is intended for engineers involved in community Trials. Once endorsed and ratified through the existing standard setting process, the Specification will support any subsequent wider roll out of hydrogen fuelled installations.

1.3 The Specification was developed by Energy & Utility Skills as part of a Hy4Heat project commissioned by the Department for Business, Energy & Industrial Strategy (BEIS) and then offered for comment to industry stakeholders. Following this consultation, the Specification was endorsed by the Standards Consultation Forum (SCF) and ratified by the Strategic Management Board (SMB).

1.4 Gas Safe registered engineers successfully completing courses, developed, and delivered in accordance with the Specification, may then be assessed through the recognised Hydrogen Assessment module.

1.5 Engineers successfully completing the hydrogen Assessment Module will be certificated as competent in matters of gas safety relating to hydrogen and have an endorsement to that effect added to their Gas Safe registration. A five-year renewal of competence in hydrogen will be required as with existing categories of work and a process to facilitate this will be developed as required.

1.6 This Specification is designed to enable existing engineers to extend their competence to include hydrogen fuelled appliances **only** in the categories they currently hold for natural gas or LPG. This Specification (and any training courses developed to meet it) **does not** facilitate or enable an engineer's changeover or conversion from domestic to non-domestic or any other category.

1.9 This Specification was published in March 2021.

2.0 SCOPE

- 2.1 This training Specification covers hydrogen transition training for:
- Existing engineers registered with GSR, holding a minimum of valid and current domestic categories: CCN1, CENWAT, CKR1 and HTR1.
 - Existing engineers registered with GSR, holding a minimum of valid and current emergency response categories: CESP1 or CESP2.
 - Existing engineers registered with GSR, holding a minimum of valid and current metering categories: CMA1 and MET1.
 - Existing engineers registered with GSR, holding a minimum of valid and current non-domestic categories: CORE A/B plus either CCCN1 or COCN1 or COLNG1, plus at least one COMCAT appliance group.

Note: these categories are subject to further clarification, dependent on the appliance requirements of planned hydrogen trials.

- 2.2 Hydrogen Training course providers who meet this Specification must emphasise that the course and subsequent competence assessment enables an engineer to carry out work **only** within the same valid appliance categories currently held for natural gas or LPG.
- 2.3 The Specification requirements include the hydrogen subject matter content that must be included in a training course, together with any specific activities that must be covered. The recommended guided learning hours provision is provided in Table 1 Appendix 1.
- 2.4 Hydrogen transition training is expected to be tutor led and primarily centre based. Given that there are no existing hydrogen networks yet installed, obtaining off site practical experience is not possible. A centre based training course must instead, take steps to provide access to a live hydrogen gas supply together with suitable appliances and equipment, to enable learners to understand and demonstrate knowledge and understanding on a range of appliances they will encounter during a hydrogen trial.

3.0 GUIDED LEARNING HOURS

- 3.1 The minimum guided learning hours for a hydrogen transition course is 25 hours. For minimum guided learning hours on consecutive learning days, each day shall be no longer than 7.5 hours or 37.5 hours per week or in the instance of day release a maximum of 10 hours.

The subjects covered in the core unit are detailed in Section 2, Table 1.

The training is to cover both the theoretical and practical aspects of the work.

4.0 EVALUATION OF TRAINING

- 4.1 Evaluation of the learning needs to be undertaken by the course provider, which supports the training, the learner, and the trainer.
- 4.2 The evaluation will be a mixture of oral, theory and performance-based assessments which will need to be conducted during and at the end of the training.
- 4.3 The marking scheme for any testing method used needs to be open and transparent to the learner and the trainer.
- 4.4 A hydrogen assessment pass mark is set at 100% for matters of gas safety in accordance with recognised industry practice.

5.0 COURSE CERTIFICATION

- 5.1 A hydrogen transition course certificate of achievement must be presented to each successful engineer. The course certificate must include: The Training Provider, the date the certificate was awarded, the name of the engineer and the engineer's National Insurance and Gas Safe registration number.
- 5.2 The hydrogen transition course certificate will enable the engineer to undertake the Hydrogen Competence Assessment. This assessment will only be available to engineers who have successfully completed a recognised hydrogen transition training course and have received a certificate of achievement.

6.0 COURSE DESIGN

- 6.1 The course must include a clear and concise **Aim**, together with a suite of **SMART objectives** that will deliver the requirements of this Specification.
- 6.2 The technical course content must be aligned to the specific requirements set out in the Hydrogen Interim Standard [IGEM/H/2].
- 6.3 All integrated course assessments and/or end tests must be clearly aligned to the objectives defined within the course submission for approval.
- 6.4 Each course objective must be covered by an assessment of some type, and the method to be used clearly documented in the course submission.

7.0 PROVIDER CAPABILITY

- 7.1 Trainers must, in addition to any previous recognition or qualification as a trainer in the gas industry have relevant knowledge and understanding of hydrogen in an appropriate context. The Training Provider must document all trainers that will be involved in hydrogen training as suitable for this role, based on evidence of their involvement in hydrogen research or development work in an appropriate capacity. Trainers must also achieve hydrogen transition training certification themselves and attend a specific hydrogen “Train the Trainer” event, prior to delivering a course to others.
- 7.2 The course Provider must have suitable and appropriate facilities available for the delivery of the hydrogen training, both for knowledge and understanding, input and practical simulation, practice, and assessment.
- 7.3 The course Provider must provide an appropriate range of hydrogen fuelled appliances to enable learners to observe their operation and practice defined work activities in a realistic simulated work environment. A suitable range of appliances is included in Section 2, Table 2.

SECTION 2: CENTRE BASED HYDROGEN TRANSITION TRAINING

The performance criteria (PC), knowledge and understanding (K&U) requirements for off-the-job training are structured to be consistent with the core competencies identified in the Hydrogen Skills Matrix.

The minimum guided learning hours assigned to each subject are detailed below, and incorporate time for integrated course assessment of learning.

TABLE 1

Hydrogen Core Competencies	Minimum Guided Learning Hours (including in course assessment)
Safety, Legislation and Standards	1.0
Products and Characteristics of Hydrogen Combustion	3.0
Ventilation for Hydrogen Gas Burning Appliances	1.0
Installation of Pipework and Fittings	1.0
Tightness Testing and Purging	3.0
Metering Installations	1.0
Unsafe Situations, Emergency Notices and Warning Labels	1.0
Checking and Setting Hydrogen Appliance Burner Pressures and Gas Rates	2.0
Operation and Checking of Hydrogen Appliance Gas Safety Devices and Controls	2.0
Chimney and Condensate Installation, Inspection and Testing	2.0
Re-establish Existing Gas Supply and Re-light Appliances	2.0
Commissioning of Appliances	1.0
Handover and Customer Engagement	1.0
Service and Maintenance	1.0
Gas Emergency Actions and Procedures	1.0
Dealing with Reported Gas Escapes	2.0
Total:	25 hours

TABLE 2

Hydrogen Appliances required for Training Purposes	Minimum Number
Heating Boilers (various manufacturers)	2
Cooker or Hob unit (domestic or non-domestic)	1
Gas Fire and/or Heater	1
Meters	1

SECTION 3: PERFORMANCE AND KNOWLEDGE CRITERIA

The criteria included below relate to each of the core competences shown in Section 1, Table 1. Where Performance criteria are shown, learners must demonstrate their ability to carry out the actions described. Learners must also demonstrate knowledge and understanding, through oral questioning or written testing of aspects shown as knowledge criteria. As appropriate, specific reference to relevant information in the Hydrogen Interim Standard, relating to each criterion, is shown in brackets as follows (H/2 Section/Clauses)

Safety, Legislation and Standards

Knowledge and Understanding criteria

In relation to working on hydrogen gas installations the learner will need to demonstrate knowledge and understanding of the following aspects, as they apply to the range of both domestic and non-domestic installations and appliances:

- K1 Application of the Gas Safety Installation and Use Regulations. (H/2 Section 3.2).
- K2 Specific requirements relating to hydrogen installations and appliances. (H/2 Section 8).
- K3 Safety precautions when other hazardous materials are encountered whilst working on hydrogen installations. (H/2 Section 4).
- K4 The learner responsibilities regarding health, safety, and the environment. (H/2 Section 4).
- K5 Use of personal protective equipment. (H/2 Section 4).
- K6 New Standards, Engineering Instructions and/or Codes of Practice relating specifically to hydrogen installations and applications (H/2 all Sections).
- K7 Risk assessment methodology as applied to the suitability of existing installation pipework and Equipment (H/2 Section 5).
- K8 Record keeping and filing of risk assessment, as necessary (H/2 Section 4.1).
- K9 Suitable, approved and prohibited materials for use with hydrogen installations and appliances (H/2 Section 7).

Products and Characteristics of Hydrogen and Combustion

Performance Criteria

In relation to complete combustion, the learner will need to be able to:

- P1 State significant behavioural differences of hydrogen compared with hydrocarbon gases (H/2 all Sections).
- P2 Identify correct flame performance (H/2 Sections 8.1.3, 8.1.4).
- P3 Analyse products of combustion for correct oxygen content (H/2 Sections 8.1.3, 10.4.6).
- P4 Identify false positives and early warning devices of a hydrogen gas escape (H/2 Section 3.2).

In relation to approved gas detectors and indicators, the learner will need to be able to:

- P5 Identify and operate approved gas detectors for use with hydrogen. (H/2 Section 3.2).

In relation to combustion performance analysis, the learner will need to be able to:

- P6 Undertake combustion performance analysis on a hydrogen appliance. (H/2 Section 8.1.3).

Knowledge and Understanding

In relation to complete and incomplete combustion, the learner will need to know and understand:

- K1 Combustion equations relating to hydrogen.
K2 Oxygen requirements for complete combustion.

In relation to combustion performance analysis, the learner will need to know and understand:

- K3 Actions to take when undertaking combustion performance analysis. (H/2 Section 8.1.3).

In relation to combustion and its controls, the learner will need to know and understand:

- K4 Why hydrogen is not subject to incomplete combustion.
K5 Products and characteristics of combustion.
K6 Ignition temperature and flammable range.
K7 How to use a gas analyser to measure oxygen content.
K8 Flame picture, flame lift and light back.
K9 Burner types.
K10 Gas controls.
K11 Fault diagnosis
K12 Safety devices
K13 Condensate requirements
K14 CO Alarm false positive alarms on hydrogen gas escapes

Ventilation for Hydrogen Gas Burning Appliances

Performance Criteria

In relation to providing ventilation for domestic gas burning appliances, the learner will need to be able to: (H/2 Section 8.1.2)

- P1 Explain procedures for the control of moisture from hydrogen appliances
P2 Identify correct and incorrect ventilation provision.
P3 State the importance of, and requirements for compartment ventilation

Knowledge and Understanding

In relation to providing ventilation for domestic gas burning appliances, the learner will need to know and understand: (H/2 Section 8.1.2)

- K1 Factors affecting ventilation.

- K2 Design and types of ventilation provision.
- K3 Calculating ventilation requirements for hydrogen installations.
- K4 Ventilation labels and notices.
- K5 Air supply requirements for cooling and combustion.
- K6 Mechanical ventilation and extraction.
- K7 Design and materials.
- K8 Free area and position.
- K9 Route and configuration.
- K10 Maintenance.

Installation of Pipework and Fittings

Knowledge and Understanding (H/2 Sections 7.1, 7.2, 7.3, 7.4, A1.1 and Table A1.2)

In relation to the installation of domestic pipework and fittings, the learner will need to know and understand:

- K1 Factors to consider when installing gas installation pipework for use with hydrogen.
- K2 Copper and mild steel pipe and fittings standards, suitability, and use.
- K3 Approved Jointing and cleaning agents for jointing copper and threaded pipework fittings.
- K4 Restrictions on use of union and compression fittings.
- K5 Pipe sizing for hydrogen installations.

Tightness Testing and Purging

Performance Criteria (H/2 Sections 9.1, 9.2, 9.3, 10.1, 10.2, 10.3, 10.4, 10.5, 10.6 and 10.7)

In relation to testing and purging domestic hydrogen gas installations, the learner will need to be able to:

- P1 Test low-pressure Hydrogen gas installations for tightness using gas.
- P2 Purge low-pressure hydrogen gas installations.
- P3 Trace and repair a downstream hydrogen gas escape.

Knowledge and Understanding (H/2 Sections 9.1, 9.2, 9.3, 10.1, 10.2, 10.3, 10.4, 10.5, 10.6 and 10.7)

In relation to testing and purging domestic natural gas installations, the learner will need to know and understand:

- K1 Define operating pressures for hydrogen installations
- K2 Types of pressure gauge and perceptible movement.
- K3 Application of permissible pressure loss.
- K4 Dealing with let by.

- K5 Actions to take when a smell of gas persists after a satisfactory test or after the ECV has been turned off.
- K6 Calculating installation and purge volumes
- K7 Potential need for inert purging of existing installations
- K8 Testing pipework of diameter > 35 mm or total IV > 0.035 m³.
- K9 Testing before working on an installation.

Metering Installations

Performance Criteria (H/2 Sections 6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 6.8)

In relation to checking and/or setting meter regulators on natural gas installations, the learner will need to be able to:

- P1 Check that the meter fitted is for use with hydrogen
- P2 Check that the hydrogen meter is correctly located, installed, and labelled
- P3 Measure and record the installation standing pressure.
- P4 Measure and record the installation working pressure.
- P5 Determine if the installation working pressure is correct or incorrect.
- P6 State the actions to take if the working pressure is incorrect.
- P7 Test and adjust the operation of Excess Flow Valves as necessary

Knowledge and Understanding (H/2 Sections 6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 6.8)

In relation to checking and/or setting meter regulators on hydrogen gas installations, the learner will need to know and understand:

- K1 The correct types of meter approved for use with hydrogen.
- K2 The need for, and purpose of an Excess Flow Valve on a hydrogen installation.
- K3 Meter box and enclosures approved for use with hydrogen meters.
- K4 Safety notices and labels.
- K5 Location criteria for hydrogen meter installations.
- K6 Meter installation, exchange, and removal of hydrogen meters.
- K7 Operation of Smart Meter excess flow valve.

Unsafe Situations, Emergency Notices and Warning Labels

Performance Criteria (H/2 Sections 4.1, 6.8.1, 7.3, 7.10, 7.11, 7.12, 7.13, 7.14)

In relation to unsafe situations, emergency notices and warning labels, the learner will need to be able to:

- P1 Identify and classify different categories of unsafe situations.
- P2 Demonstrate the procedure to follow for each classification of unsafe situation.

P3 Complete, explain and issue appropriate warning/advisory labels and notices.

Knowledge and Understanding (H/2 Section 4.1)

In relation to unsafe situations, emergency notices and warning labels, the learner will need to know and understand:

- K1 IGEM/G/11 - Gas Industry Unsafe Situation Procedure (GIUSR).
- K2 Situations reportable under RIDDOR.
- K3 Situations reportable to Gas Safe Register and/or HSE which are not RIDDOR reportable.
- K4 Correct use of notices and labels.

Checking and Setting Hydrogen Appliance Burner Pressures and Gas Rates

Performance Criteria (H/2 Sections 4.1, 8.1.3, 8.1.4)

In relation to checking and setting hydrogen appliance burner pressures and gas rates, the learner will need to be able to:

- P1 Measure an appliance operating pressure.
- P2 Measure an appliance gas rate.

Knowledge and Understanding (H/2 Section 4.1, 9.2.1)

In relation to checking and setting appliance burner pressures and gas rates, the learner will need to know and understand:

- K1 Requirements for range rated appliances.
- K2 Requirements for variable-rated appliances
- K3 Causes and effects of pressure loss.
- K4 Use of electronic pressure gauge.

Operation and Checking of Hydrogen Appliance Gas Safety Devices and Controls

Performance Criteria (H/2 Section 8.1)

In relation to gas safety devices and controls the learner will need to be able to:

- P1 Identify hydrogen gas specific safety devices and controls.
- P2 Check gas safety devices and controls for correct operation and carry out any corrective action where necessary.
- P3 Explain the operation of gas safety devices and controls.

Knowledge and Understanding (H/2 Section 4.1)

In relation to gas safety devices and controls the learner will need to know and understand:

- K1 The principles of operation of hydrogen gas safety devices and controls.
- K2 The sequence of operation of hydrogen gas safety devices and controls.

Chimney Installation, Condensate Management, Inspection and Testing**Performance Criteria** (H/2 Sections 4.1, 8.1.2, 8.1.3, 8.1.4)

In relation to chimney testing the learner will need to be able to:

- P1 Visually inspect chimney systems to confirm correct and incorrect installation.
- P2 Perform a spillage test on a hydrogen appliance connected to an open flue system.
- P3 Carry out a Flue Flow Test
- P4 Perform a combustion case seal test on a room sealed fan assisted positive pressure appliance.

Knowledge and Understanding: (H/2 Sections 4.1, 8.1.2, 8.1.3, 8.1.4)

In relation to chimney installation inspection and testing the learner will need to know and understand:

- K1 Causes of leakage of combustion products from room sealed positive combustion chamber pressure appliances.
- K2 Condensate management and discharge to waste
- K3 Condensate production from hydrogen appliances
- K4 How and where condensate may be discharged
- K5 Actions to take when inspection hatches are not available for flues in voids.

Re-establish Existing Gas Supply and Re-light Appliances**Performance Criteria** (H/2 Sections 4.1, 8.1.3, 9.1, 9.2, 9.3)

In relation to re-establishing an existing hydrogen gas supply and re-lighting the appliances, the learner will need to be able to:

- P1 Check the installation is gas tight.
- P2 Purge the installation and appliances of air.
- P3 Establish a stable flame on each appliance.
- P4 Check operation of any Flame Failure Device (FFD).
- P5 Visually inspect each appliance for unsafe situations.
- P6 Confirm satisfactory operation of user controls.

Knowledge and Understanding (H/2 Sections 4.1, 8.1.1, 8.1.2, 8.1.3)

In relation to re-establishing an existing hydrogen gas supply and re-lighting the appliances, the learner will need to know and understand:

- K1 Actions to take when an un-commissioned appliance is identified.
- K2 Actions to take if pipework and appliance(s) are not tested (commissioned) when the gas supply is re-established.

Commissioning of Appliances**Performance Criteria** (H/2 Sections 4.1, 8.1.2, 8.1.3, 8.1.4)

With reference to the range of domestic or non-domestic appliances, some of which may have specialist requirements, the learner will need to be able to:

- P1 Demonstrate the ability to commission a hydrogen appliance in accordance with Manufacturer's Instructions.

Knowledge and Understanding (H/2 Sections 4.1, 8.1.2, 8.1.3, 8.1.4)

In relation to appliance commissioning, the learner will need to know and understand:

- K1 Specific commissioning requirements of hydrogen appliances
- K2 Operational checks and procedures required prior to handover
- K3 Sources of additional information or support for hydrogen installations
- K4 Essential information on hydrogen usage to communicate with the end user

Handover and Customer Engagement**Performance Criteria**

On completion and commissioning of a hydrogen appliance and installation, ready for handover to a consumer, the learner will need to be able to:

- P1 Handover the appliance to the end user, explaining appliance operation in accordance with manufacturer's instructions. (H/2 Sections 4.1, 8.1.3).
- P2 Explain and demonstrate specific new features of hydrogen appliances (H/2 Sections 4.1, 8.1.3).

Knowledge and Understanding

To complete a successful handover procedure, the learner will need to know and understand:

- K1 Background to hydrogen transition.
- K1 Development, research and testing to confirm safety of hydrogen as an alternative to natural gas.
- K3 Benefits to consumers of hydrogen as a fuel.

Service and Maintenance

Performance Criteria (H/2 Sections 4.1, 8.1.2, 8.1.3, 8.1.4)

Notwithstanding differences between types of domestic and non-domestic appliances, the learner will need to be able to:

- P1 Demonstrate the ability to adjust appliance components as necessary to manufacturer's instructions.
- P2 Recommission hydrogen appliances to full working operation.

Knowledge and Understanding (H/2 Sections 4.1, 8.1.2, 8.1.3, 8.1.4)

In relation to the maintenance of appliances, the learner will need to know and understand:

- K1 Specific maintenance and servicing requirements of hydrogen appliances.
- K2 Operational maintenance procedures.
- K3 Appliance performance checks to be carried out following maintenance work.
- K4 Combustion products checks and analysis.
- K5 Interpretation of data resulting from combustion product analysis.

Gas Emergency Actions and Procedures

Knowledge and Understanding

In relation to emergency actions, the learner will need to know and understand:

- K1 Properties and characteristics of Hydrogen gas.
- K2 Priorities and actions when dealing with hydrogen gas escapes and incidents.

Dealing with Reported Gas Escapes

All engineers carrying out work on hydrogen installations must have the capability to act appropriately in the event of a potential reported, or actual leakage of hydrogen from the installation.

Performance Criteria (H/2 Sections 4.1, 9.2, 9.3, 10.4.6)

- P1 Carry out immediate steps to make the installation safe
- P2 Complete tightness testing in accordance with hydrogen specific procedures
- P3 Initiate appropriate actions dependent upon tightness test outcome
- P4 Demonstrate correct use of appropriate gas detection equipment

Knowledge and Understanding (H/2 Section 4.1)

To deal effectively with reported hydrogen gas escapes, the learner will need to know and understand:

- K1 Hydrogen Installation Emergency Procedures
- K2 Evacuation criteria and procedures
- K3 Essential communication with customer(s)
- K4 Sources of support and additional resources if required
- K5 Effective liaison with Network Distribution personnel assisting in detection and repair
- K6 Communication with third parties such as emergency services

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