

Energy & Utility Skills – Hydrogen Competence Framework

Stage 1.2: Gas Utilisation Skills Matrix

Post Consultation Edition 14th August 2020

Introduction

This skills matrix follows the recent comparative analysis report that sought to identify the significant differences between hydrogen and the more familiar hydrocarbons currently in use. The report considered these differences from a gas installation and maintenance engineer perspective and considered the role of a person responding to a reported gas escape (usually known as a “first call operative”, or FCO). This skills matrix develops the report information further, and defines the additional skills, knowledge and understanding necessary for Gas Safe Registered engineers to be competent to undertake work on a hydrogen installation within the scope of the Hy4Heat, Hydrogen Competence Framework.

Skills Matrix Format

The matrix provides a breakdown of the competence requirements for gas utilisation personnel working with hydrogen and categorises the aspects as needing either additional skills, or additional knowledge and understanding. A rationale for each aspect is included, together with an assessment of the breadth and depth of knowledge required to achieve competence.

Purpose and Next Stage

Once the skills matrix has been signed off as “fit for purpose” through the industry and stakeholder consultation process, the information will be used to develop both a hydrogen utilisation training specification and a competence assessment. The training specification will enable the training provider to produce a course that meets the IGEM/IG/1 Standard for Training in Gas Work. **Please note:** *This Matrix does not include detailed Training Course information about the identified aspects, or how they may/must be delivered by a provider. This information will be a core element of 2.1: Training Specification, which is scheduled for delivery as a consultation draft by mid-September.*

Once the Training Specification has been signed off, the final stage is to develop a hydrogen assessment in accordance with the standard setting and governance requirements facilitated by EU Skills i.e. via the Standards Consultation Forum (SCF) and ratified by the Strategic Management Board (SMB)

Feedback and Comments

Industry and stakeholder feedback is much appreciated, and all comments to date have been carefully considered and captured for inclusion in the final Hydrogen Competence Framework. This skills matrix is another important building block for that framework and the gas industry has an opportunity to shape the competence framework to ensure that it delivers a safe and robust approach.

Skills Matrix v.1.0

Key and definition of terms	
K/U	A Knowledge and Understanding component of competence
Skills	Completion of a task requiring an application of a practical skill or capability
Active awareness required	
Comprehensive understanding required	
Practical demonstration of skills required	
Assessment Type: Theory	May be assessed by questions or desktop exercises
Assessment Type: Practical Exercise	May be assessed by interactive online exercise or classroom model
Assessment Type: Practical Test	Must be physically demonstrated by learner

Ref.	Aspect	Category	Rationale	Knowledge and Understanding / Skills required	Colour code	Assessment Type
1.0	Properties of hydrogen	K/U	The fundamental differences between hydrogen and current gases must be well understood if safe working is to be achieved. Particularly important to understand that hydrogen may have a detrimental effect on some materials used in an installation. These may include pipework systems, fittings, components, and seals.	A broad and comprehensive understanding of the technical challenges posed by using hydrogen, particularly when installing new appliances to existing installations. Also, a need to understand the behaviour of hydrogen, notably the combustion, burning velocity and calorific value of hydrogen and how that is accommodated to deliver the same end user energy expectations		Theory
2.0	Behaviour of hydrogen	K/U	Need to understand how hydrogen behaves in comparison with other hydrocarbon gases, in a range of situations, including the ventilation requirements, combustion itself and the composition of products of combustion, as well as dispersal in air and potential hazardous zones	Relative to the more familiar existing gases used, a good understanding of how hydrogen behaves will be essential. The key differences in the flammability range, ignition point, air requirement and products of combustion		Theory

3.0	Legislation and applicable regulations	K/U	Although existing gas safe registered personnel will be expected to have good knowledge and understanding of current relevant legislation and regulations, some of these documents will have been amended to incorporate the utilisation of hydrogen. In addition, new technical standards have been produced and these will need to be understood by a competent person.	Comprehensive understanding of all new statutory requirements relating to hydrogen, and all new hydrogen specific technical standards. Also, recognition that existing generic statutory requirements such as Health & Safety at Work Act, Gas Safety (Management) Regulations and Gas Safety (Installation & Use) Regulations will still apply, albeit with potential specific hydrogen additions		Theory
4.0	Risk assessment	Skill	The change to hydrogen will necessitate careful assessment of the installation site and all existing installation carcass and materials that have been used. Other considerations such as the need to manage suitable condensate discharge to drain.	The ability to carry out a standard risk assessment on an existing installation to ensure that existing materials and potential appliance installation locations are suitable for hydrogen and meet manufacturer's instructions. Also includes the capability to act accordingly once the risk assessment has been completed		Practical exercise
5.0	Acceptable materials	K/U	Certain materials are unsuitable for use in hydrogen installations. These will include specific types of fittings, threaded steel joints and specific types of sealant. It will therefore be necessary for personnel to identify any potential unsafe situation prior to the introduction of hydrogen.	Aligned to the risk assessment capability, personnel need to be able to identify hydrogen acceptable and non-acceptable materials from a list of those that are in common use and may be found in an existing installation		Practical exercise
6.0	Appliance design changes	K/U	Manufacturers have designed appliances either for exclusive hydrogen application, or that will burn both hydrogen and hydrocarbons, subject to the correct installation and commissioning process being adhered to. Therefore, personnel must be able to recognise the type of appliance and have the capability to adjust appliance parameters where necessary in accordance with manufacturer's instructions.	Personnel must understand the design changes carried out by manufacturers to enable correct performance using hydrogen. These changes may involve appliance component adjustment, ventilation, flue installation and termination and condensate discharge requirements.		Theory

7.0	Installation procedures	K/U	Although likely to follow similar processes and procedures as currently used, the use of hydrogen will require careful consideration of those aspects (previously referred to within this matrix) that may be different due to the change of fuel.	Comprehensive understanding of those aspects of installation procedures that will be different due to the nature of hydrogen as the fuel source.		Theory
8.0	Ventilation	K/U	The combustion of hydrogen requires less air than natural gas and installations that have previously operated with natural gas appliances, should not require additional ventilation. However, the wider flammability limits, increased buoyancy and ignition sensitivity of hydrogen require personnel to have the capability to demonstrate skills accordingly in respect of work practices and procedures.	Comprehensive understanding of the practical application and requirements explained in 1.0 and 2.0 of this Matrix. Personnel must be competent in determining the required ventilation rate and know the consequences of a failure to provide the correct amount of air for complete hydrogen combustion.		Theory
9.0	Products of Combustion	K/U	The products of hydrogen combustion are significantly different to those produced through combustion of natural gas and other hydrocarbons. While no carbon is produced except for an imperceptible amount arising from the odourant combustion, increased water vapour and some Nitrogen Oxides is produced, and these differences must be taken into account.	An understanding of combustion equations for both natural gas and hydrogen would enable personnel to recognise differences in combustion performance outcomes. The potential impact of the increased water content in practical design and installation terms is also important and must be understood to enable safe installation in accordance with manufacturer's instructions.		Theory

10.0	Metering	K/U	<p>Meters for hydrogen will be different, although some may be able to measure both natural gas and hydrogen. In any event, the appropriate and correct meter must be installed whichever gas is being used for the installation. Labelling is highly likely to be important and so personnel must know what to look for and how to identify the correct meter. There will be an additional excess flow valve required as part of the meter installation for hydrogen</p>	<p>Personnel must be able to distinguish the differences between a hydrogen meter and a natural gas meter and make sure an appropriate meter is installed for the gas being used. in a particular installation.</p> <p>If a meter may be used for more than one gas, and may be switched or set on site, then personnel must have the capability to carry out this task, add any necessary labels and make any necessary reports.</p> <p>A good understanding of how any excess flow valve operates, together with associated installation or maintenance requirements will be important</p>		Theory
11.0	Tightness testing	Skill	<p>The existing suite of Testing Standards do not yet cover the procedures for hydrogen. Nonetheless, this aspect will be a critical component of the competence framework. The capability to carry out a tightness test, in accordance with the correct standard (or relevant engineering instruction if a standard is yet to be published) will be absolutely fundamental.</p>	<p>The equipment used and the current tightness testing procedure downstream of the ECV is unlikely to change however, a requirement for zero pressure loss on all installations within the scope of this framework is anticipated, therefore personnel must be trained and assessed competent to undertake a hydrogen tightness test.</p>		Practical Test

12.0	Purging practice	Skill	One of the most critical aspects of the competence framework, due to the increased complexity of the safety related requirements for the purging process for hydrogen.	Derived from the properties and characteristics of hydrogen (ref. 1.0 and 2.0) the purging procedures for hydrogen are likely to be significantly different than those adopted for natural gas. As with tightness testing, the existing standards are limited in their coverage of hydrogen purging. That said, the capability of personnel to carry out a safe purging procedure on a hydrogen installation, to a given standard (or an engineering instruction pending the publication of a standard) is critical.		Practical Test
13.0	Commissioning	K/U	In common with existing natural gas or LPG appliances, a newly installed appliance will need to be commissioned in accordance with the manufacturer's instructions. This will be particularly important where an appliance has been designed to operate on either hydrogen or natural gas.	<p>The commissioning process and procedure for a hydrogen fuelled appliance is unlikely to change however, additional checks may be required.</p> <p>Some manufactures will develop Hydrogen ready appliances, these will need to be adapted to burn the correct fuel, it will be essential that personnel understand how this may be achieved and have the capability to carry out the task.</p>		Theory and Practical Test
14.0	Combustion analysis	Skill	Most existing combustion analysers monitor CO/CO ₂ ratios as the primary criteria for complete combustion. As no CO/CO ₂ is produced by hydrogen combustion, different equipment and/or methods of monitoring satisfactory combustion performance will be required	Personnel will need to be able to understand the rationale for using a different type of analyser, and have the competence to analyse, calibrate and carry out maintenance checks on any new equipment introduced.		Practical Test

15.0	Leakage detection	Skill	It is anticipated that a dedicated gas leak detection instrument will be required if an escape of hydrogen gas is suspected. Personnel will need to be competent to operate leak detection equipment to manufacturer's instructions.	Personnel will need to understand the rationale for using a different type of detection equipment and are competent to undertake calibration of the equipment, testing, analysis and maintenance checks on new leak detection equipment.		Practical Test
16.0	Unsafe Situations	K/U	Personnel will be familiar with the existing Unsafe Situations guidance and how to deal with situations that may arise. The use of hydrogen will inevitably pose some additional potentially unsafe situations and it will be essential that personnel have the capability to identify them and know how to respond, resolve, and report these in accordance with the relevant procedure.	Good understanding of the potential for unsafe situations arising from the use of hydrogen. Personnel must know what procedures are in place to respond in a range of circumstances and know how to report and ensure that any safety concerns or hazards are dealt with in the correct manner.		Theory
17.0	Handover and future maintenance	Skill	Following any gas installation or maintenance work, the installation or maintenance operative must leave the installation safe and instruct the occupier/user how to use the appliance safely. Once the gas operative has left the premises, the continued safety of the installation is in the hands of the user. It is therefore essential that engagement with the occupier or user is clear and robust.	Consumer trust and a positive customer relationship is important through the hydrogen transformation therefore good communication skills between the installation personnel and the end user are important to avoid unintended consequences. While some customers will be indifferent to the change of gas, others will want to engage more extensively and ask questions. To provide reassurance about the conversion, personnel will need to be well briefed and able to answer a wide range of possible questions.		Practical Test

18.0	Dealing with PRE	Skill	<p>Particularly relevant to the FCO role, the use of hydrogen will demand new procedures, new equipment (see 15.0) and a comprehensive understanding of the properties and behaviour of hydrogen if a leak occurs. Effective liaison and informed communication with distribution colleagues and third parties such as police and fire brigade will also be essential.</p>	<p>An understanding of hydrogen as a fuel, how the gas behaves if a leak occurs and what hazards are created. Also, excellent grasp of all procedures relating to trace, locate and repair activities, including evacuation criteria and safe working practices. Personnel will need the capability to liaise effectively with distribution colleagues and others to restore supply and make safe.</p>		<p>Practical test (for FCO)</p>
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