

PAS 4441:2024

Components used in hydrogen gas metering – Specification



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Energy Security
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Foreword

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The PAS process enables a specification to be rapidly developed in order to fulfil an immediate need in industry. A PAS can be considered for further development as a British Standard, or constitute part of the UK input into the development of a European or International Standard.

Relationship with other publications

This PAS is related to the following standards:

- PAS 4442, *Material requirements for pipework and fittings used in hydrogen gas installation – Specification*
- PAS 4443, *Assessment criteria: Ancillary valves, devices and components used in hydrogen gas installations – Specification*
- PAS 4444, *Hydrogen-fired gas appliances – Guide*

Information about this document

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The diagram in 6.2.1, Figure 3 of this PAS is a modified version of an image supplied by KIWA.

Presentational conventions

The provisions of this PAS are presented in roman (i.e. upright) type. Its requirements are expressed in sentences in which the principal auxiliary verb is “shall”.

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

Where words have alternative spellings, the preferred spelling of the *Shorter Oxford English Dictionary* is used (e.g. “organization” rather than “organisation”).

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Introduction

The Hydrogen Skills and Standards for Heat programme is developing technical standards for domestic and non-domestic hydrogen gas installations, as well as associated competence frameworks and training specifications for installers. These aim to enable the existing natural gas system to be repurposed for use with 100% hydrogen downstream of the emergency control valve (ECV).

The standards developed define the required criteria to safely repurpose existing natural gas equipment for hydrogen, to design and install new hydrogen safe pipework and appliances, and to train a workforce of competent hydrogen gas installers. This work intends to contribute evidence informing strategic decisions in 2026 on the role of hydrogen in heat decarbonisation. The programme forms part of the Department for Energy Security and Net Zero's Net Zero Innovation Portfolio (NZIP) and Clean Heat Directorate – Hydrogen Heating.

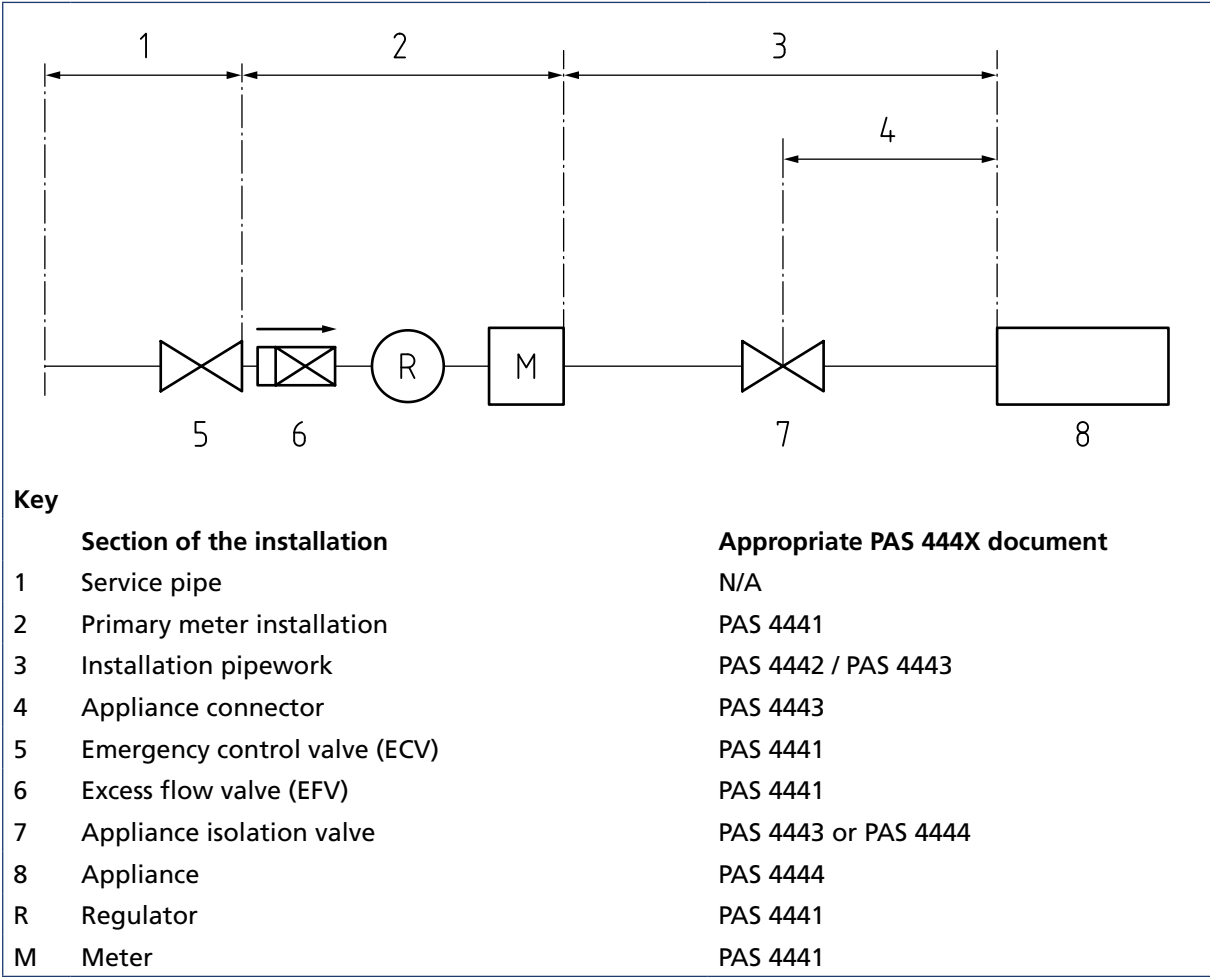
As part of this programme, BSI have developed a series of PAS standards that codify an agreed set of principles, requirements and guidance on the functionality, safety, installation, operating and servicing requirements for hydrogen meters, pipework, fittings, and ancillary devices.

The Hydrogen Skills and Standards for Heat programme PASs are:

- PAS 4441, *Components used in hydrogen gas metering – Specification*
- PAS 4442, *Material requirements for pipework and fittings used in hydrogen gas installation – Specification*
- PAS 4443, *Assessment criteria: Ancillary valves, devices and components used in hydrogen gas installations – Specification*

The interrelationship between PAS 4441, PAS 4442, PAS 4443 and PAS 4444 and their applicability to a typical hydrogen 4th family gas installation is illustrated in Figure 1.

Figure 1 – Interrelationship between PASs for typical hydrogen 4th family gas installation



1 Scope

This PAS specifies performance requirements for components used in and around the hydrogen gas meter.

This PAS covers meters and any excess flow valve (EFV), or device with EFV functionality, and other associated equipment, e.g. meter box and pliable connections supplied for use with, hydrogen.

This PAS specifies the performance requirements for each component associated with meter installation to ascertain its safety.

It predominately applies to primary meter installations, although can apply to secondary meters, where applicable.

This PAS covers both domestic and non-domestic meters, in commercial and light industrial premises, up to a size of 3 600 kW HHV (3 050 kW LHV) (~1 076 m³/h) and up to 250 mbar [energy and power values are listed as higher heating value (HHV)].

NOTE 1 Reference conditions for units of volumetric gas flow (m³) are 15 °C and 1 013.25 mbar (absolute).

This PAS is intended for hydrogen of quality between 100.0% and that specified in PAS 4444.

This PAS is intended for use with:

- domestic and light commercial gas supplies less than 20 m³/h, connected to low pressure networks in the range of 26.8 to 75.0 mbar; and
- large commercial and light industrial users where the maximum nominal operating pressure is < 250 mbar.

The PAS does not cover components up to the regulator of these higher-pressure installations.

NOTE 2 This PAS also references other relevant gas metering standards, including smart metering standards, such as SEC Schedule 9, Smart Metering Equipment Technical Specifications 2 (SMETS2). The latter is embedded within the GB Gas Industry Network Code.

NOTE 3 For large commercial and light industrial users <250 mbar this PAS contains no hydrogen demand limitation.

This PAS is intended for use by manufacturers of hydrogen-fired gas and gas appliances.

This PAS might be of interest to:

- 1) safety standards personnel;
- 2) test houses;
- 3) approved bodies (UK) and notified bodies (EU);
- 4) consultants;
- 5) gas distribution network operators (GDNs);
- 6) gas suppliers and shippers;
- 7) code bodies;
- 8) meter equipment managers; and
- 9) government bodies and regulators.

This PAS might also be of interest to architects, property developers, builders, mechanical and electrical contractors, Gas Safe registered installers and surveyors, and other associated gas equipment manufacturers.

This PAS is intended for use in England, Scotland and Wales but can be used internationally under local gas regulations.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes provisions, or limits the application, of this document¹⁾. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

Standards publications

PAS 4443, *Assessment criteria: Ancillary valves, devices and components used in hydrogen gas installations – Specification*

PAS 4444:2020+A1:2021, *Hydrogen-fired gas appliances – Guide*

BS 6400-1, *Specification for installation, exchange, relocation, maintenance and removal of gas meters with a maximum capacity not exceeding 6 m³/h – Part 1: Low pressure (2nd family gases)*

BS 8499, *Specification for domestic gas meter boxes and meter bracket*

BS EN 88-1, *Safety and control devices for gas burners and gas burning appliances – Pressure regulators for inlet pressures up to and including 50 kPa*

BS EN 161, *Automatic shut-off valves for gas burners and gas appliances*

BS EN 437, *Test gases – Test pressures – Appliance categories*

BS EN 746-2, *Industrial thermoprocessing equipment – Safety requirements for combustion and fuel handling systems*

BS EN 1359, *Gas meters – Diaphragm gas meters*

BS EN 12261, *Gas meters – Turbine gas meters*

BS EN 12480, *Gas meters – Rotary displacement gas meters*

BS EN 14236, *Ultrasonic domestic gas meters*

BS EN 16314, *Gas meters – Additional functionalities*

BS EN 17526, *Gas meter – Thermal-mass flow-meter based gas meter*

DIN 3389-1, *Ready-made insulated joint – Part 1: Insulating couplings for service lines and gas installations – Requirements and tests*

Other publications

INSTITUTION OF GAS ENGINEERS AND MANAGERS (IGEM). IGEM/G/10, *Non-return valves*. Derby: IGEM.²⁾

ENERGY NETWORKS ASSOCIATION (ENA). GIS/E17-2:2018, *Insulation joints – Part 2: Joints operating at pressures not greater than 7 bar*. London: ENA, 2018.³⁾

INSTITUTION OF GAS ENGINEERS AND MANAGERS (IGEM). IGEM/G/1+A: 2013, *Defining the end of the network*. Derby: IGEM.⁴⁾

¹⁾ Documents that are referred to solely in an informative manner are listed in the Bibliography.

²⁾ Available at <https://www.igem.org.uk/resource/igem-g-10-non-return-valves.html>.

³⁾ Available at <https://www.energynetworks.org/assets/images/Resource%20library/GIS-E17-2%202018%20with%20correction.pdf>.

⁴⁾ Available at <https://www.igem.org.uk/resource/igem-g-1-a-2013-defining-the-end-of-the-network.html>.