BS 8660-1:2011

BSI Standards Publication

Gas-fired micro-cogeneration appliances of rated thermal input not exceeding 70 kW net

Part 1: Specification for selection, installation, inspection, commissioning, servicing and maintenance of Stirling engine micro-cogeneration appliances

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Contents

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 58, an inside back cover and a back cover.

Foreword

Publishing information

This British Standard is published by BSI and came into effect on 30 November 2011. It was prepared by Panel GSE/30/-/5, *Boilers of rated input not exceeding 70kW and hot water supply*, under the authority of Technical Committee GSE/30, *Gas installations (1st, 2nd and 3rd family gases)*. A list of organizations represented on this committee can be obtained on request to its secretary.

Information about this document

BS 8660, *Gas-fired micro-cogeneration appliances of rated thermal input not exceeding 70 kW net*, will eventually comprise the following parts.

Part 1: Specification for selection, installation, inspection, commissioning, servicing and maintenance of Stirling engine micro-cogeneration appliances.

Part 2: Specification for selection, installation, inspection, commissioning, servicing and maintenance of Fuel Cell micro-cogeneration appliances.

Part 3: Specification for selection, installation, inspection, commissioning, servicing and maintenance of Organic Rankine Cycle micro-cogeneration appliances.

The structure follows the approach used in other gas installation standards.

Requirements, with corresponding commentary, cover equipment selection and pre-installation, installation and post-installation, to which maintenance has been added as a specific detail.

In line with BS 5440-1, this standard acknowledges that European work on chimney standards has brought about the need in British Standards to redefine chimney concepts and adopt common terminology consistent with the range of products used across the whole European community (the general requirements for which are specified in BS EN 1443) where a chimney is treated as a structure containing a flue (the passageway) and possibly a liner (inner wall), insulation and an outer wall. The common terminology in UK industry, which has regarded a chimney as a masonry structure generally associated with solid fuel appliances, has been superseded.

Use of this document

The requirements of this specification are supported by commentary, often in the form of recommendations. To comply with this specification, it is necessary to comply with all its requirements. The operative may depart from recommendations, but would be expected to have good reasons for doing so.

This standard recognizes that manufacturers' instructions (assessed at the time of CE type testing as resulting in at least an equivalent level of safety) might specify a method of installation, testing, commissioning, servicing or maintenance which differs in points of detail from this standard. It is important that the manufacturer's instructions are followed.

Presentational conventions

The provisions of this standard 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.

Contractual and legal considerations

This publication does not purport to include all the necessary provisions of a contract. Users of the standard are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

Attention is drawn to the following statutory regulations.

- The Gas Safety (Installation and Use) Regulations 1998 (GSIUR) [1]
- Gas Safety (Installation and Use) Regulations 1994, as amended and applied by the Gas Safety (Application) (Isle of Man) Order 1996 [2]
- The Gas Safety (Installation and Use) Regulations (Northern Ireland) 2004 [3]
- The Health and Safety (Gas) (Guernsey) Ordinance 2006 [4]
- The Gas Appliance (Safety) Regulations 1995 [5]
- The Building Regulations 2000 (England and Wales), as amended [6]
- The Building Regulations (Northern Ireland) 2000, as amended [7]
- The Building (Scotland) Regulations 2004, as amended [8]
- The Building Regulations 2007 (for the Isle of Man) [9]
- The Water Supply (Water Fittings) Regulations 1999, as amended [10]
- The Electrical Safety, Quality and Continuity Regulations 2002 [11]
- The Electrical Equipment (Safety) Regulations 1994 [12]
- Electromagnetic Compatibility Regulations 2006 [13]

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1 Scope

This part of BS 8660 specifies requirements for the selection, installation, inspection, commissioning, servicing and maintenance of room-sealed gas-fired Stirling engine micro-cogeneration appliances and their protection devices designed to operate in parallel with public low-voltage distribution networks.

NOTE 1 Sometimes micro-cogeneration appliances are referred to as small-scale embedded generators (SSEG), e.g. in Engineering Recommendation G83/1/1.

NOTE 2 A room-sealed appliance is designated as Type C in PD CEN/TR 1749.

The term "micro-cogeneration appliance" refers to equipment that:

- is rated up to and including 16 A per phase, single or multiphase 230/400 V a.c.;
- has a total rated heat input not exceeding 70 kW, based on net calorific value;
- utilizes 1st, 2nd or 3rd family gases and is designed to operate in the condensing mode for the heating of domestic dwellings, including domestic dwellings in commercial premises, by the circulation of heated water in open or closed systems;
- has been shown to meet the type verification tests in the appropriate annex of Engineering Recommendation G83/1/1;
- carries a CE mark (see **6.2.1**).

This standard does not apply to:

- micro-cogeneration appliances with a rated input of over 70 kW;
- groups of micro-cogeneration appliances with individual ratings of less than 70 kW with an aggregate input of greater than 70 kW.

NOTE 3 Groups of micro-cogeneration appliances with individual ratings of less than 70 kW, but with a maximum aggregate input of ≤70 kW, may be installed to this standard but specialist advice on the system design, installation and control needs to be sought from the appliance manufacturer.

It is not applicable to the detailed design and installation of the whole heating system, which is specified in BS EN 12828:2003 (incorporating corrigendum January 2009), BS EN 12831:2003 (incorporating corrigendum January 2009) and BS EN 14336:2004 (incorporating corrigendum January 2009).

NOTE 4 With the publication of BS EN 12828, BS EN 12831 and BS EN 14336, BS 5449 has been withdrawn. These standards are not aligned to UK design and installation practices; they cover commercial as well as domestic heating systems and exclude hot water. Consequently, these standards include national annexes covering all the relevant material from BS 5449.

NOTE 5 In this standard, heat input is expressed in terms of net calorific values (CV), unless stated otherwise. The ratio of gross to net heat input is approximately 1.11:1 for natural gas, 1.09:1 for propane, and 1.08:1 for butane.

*NOTE 6 It is essential that persons carrying out the installation of any micro-cogeneration appliances are competent to do so. Clause **4** gives information on competence.*

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS 476-22, *Fire tests on building materials and structures – Part 22: Methods for determination of the fire resistance of non-loadbearing elements of construction*

BS 1179, *Glossary of terms used in the gas industry*

BS 1179-6, *Glossary of terms used in the gas industry – Part 6: Combustion and utilization including installation at consumers' premises*

BS 5422:2009, *Method for specifying thermal insulating materials for pipes, tanks, vessels, ductwork and equipment operating within the temperature range –40 °C to +700 °C*

BS 5440-1, *Flueing and ventilation for gas appliances of rated input not exceeding 70 kW net (1st, 2nd and 3rd family gases) – Part 1: Specification for installation of gas appliances to chimneys and for maintenance of chimneys*

BS 5440-2, *Installation and maintenance of flues and ventilation for gas appliances of rated input not exceeding 70 kW net (1st, 2nd and 3rd family gases) – Part 2: Specification for installation and maintenance of ventilation for gas appliances*

BS 5482-1, *Code of practice for domestic butane- and propane-gas-burning installations – Part 1: Installations at permanent dwellings, residential park homes and commercial premises, with installation pipework sizes not exceeding DN 25 for steel and DN 28 for corrugated stainless steel or copper*

BS 5482-2, *Code of practice for domestic butane- and propane-gas-burning installations – Part 2: Installations in caravans and non-permanent dwellings*

BS 5970, *Code of practice for thermal insulation of pipework and equipment in the temperature range of –100 °C to +870 °C*

BS 6700, *Design, installation, testing and maintenance of services supplying water for domestic use within buildings and their curtilages – Specification*

BS 6891, *Installation of low pressure gas pipework of up to 35 mm (R1¼) in domestic premises (2nd family gas) – Specification*

BS 7671, *Requirements for electrical installations – IEE Wiring Regulations*

BS 7927, *Heating appliances for domestic applications – Portable apparatus designed to detect and measure specific combustion flue gas products – Requirements* (withdrawn)

BS EN 1491, *Building valves – Expansion valves – Tests and requirements*

BS EN 12828:2003 (incorporating corrigendum January 2009), *Heating systems in buildings – Design for water-based heating systems*

BS EN 12831:2003 (incorporating corrigendum January 2009), *Heating systems in buildings – Method of calculation of the design heat load*

BS EN 13831, *Closed expansion vessels with built in diaphragm for installation in water*

BS EN 14336:2004 (incorporating corrigendum January 2009), *Heating systems in buildings – Installation and commissioning of water based heating systems*

BS EN 50379-3, *Specification for portable electrical apparatus designed to measure combustion flue gas parameters of heating appliances – Part 3: Performance requirements for apparatus used in non-statutory servicing of gas fired heating appliances*

NOTE BS EN 50379-3 has superseded BS 7927, which is withdrawn.

BS EN ISO 4126-1, *Safety devices for protection against excessive pressure – Part 1: Safety valves*

PD 5482-3, *Code of practice for domestic butane- and propane-gas-burning installations – Part 3: Installations in boats, yachts and other vessels*

IGEM/UP/2, Edition 2, *Installation pipework on industrial and commercial premises* [1)]

UKLPG, *Code of Practice 22 – LPG Piping System Design and Installation* [2)]

Engineering Recommendation G83/1/1 June 2008, *Recommendations for the connection of Small-scale Embedded Generators (Up to 16A per Phase) in Parallel with Public Low-Voltage Distribution Networks* [3)]

3 Terms and definitions

For the purposes of this British Standard, the terms and definitions given in BS 1179, BS 1179-6 and the following apply.

3.1 chimney
structure consisting of a wall or walls enclosing a flue or flues

NOTE This includes chimneys of all materials (e.g. metal, masonry or plastic) for use with either open-flued or room-sealed appliances.

3.2 cogeneration
simultaneous generation of thermal and electrical energy in one process

3.3 controls
internal control system governing the safe operation of the primary heat source and associated equipment of the micro-cogeneration appliance

3.4 distributing main
low voltage part of the electric power system used for the transfer of electricity within an area of consumption to consumers

3.5 distribution network operator
DNO
organization that owns or operates a distribution network and is responsible for confirming requirements for the connection of a micro-cogeneration appliance to that network

NOTE 1 A DNO might also be referred to as a "distributor".

NOTE 2 See http://energynetworks.squarespace.com/electricity-distribution-map/ for locations of DNOs.

3.6 domestic dwelling
self-contained unit designed to accommodate a single household

3.7 flue
passage for conveying combustion products to the outside air

3.8 flue duct
duct containing the flue of a chimney configuration

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1) Institution of Gas Engineers and Managers. Kegworth.
2) UKLPG. Kenilworth.
3) Energy Networks Association Limited. London.

3.9 greywater
water originating from the mains water supply that has been used for bathing or washing, washing dishes or laundering clothes

3.10 hot water storage combination unit
either:

a) hot-water storage vessel with a cold water feed cistern immediately above it, the two being fabricated together as a compact unit; or

b) hot-water storage vessel with a cold water feed cistern beside it or inside it

3.11 micro-cogeneration
cogeneration with a maximum electrical output below 50 kWe

3.12 micro-cogeneration appliances

3.12.1 micro-cogeneration appliance
product placed on the market by the manufacturer to deliver safely and effectively heating, electrical power and, where applicable, domestic hot water

NOTE This product may take the form of:

a) a single package, packed by the appliance manufacturer, containing all the components necessary for the complete appliance;

b) a number of packages, packed by the appliance manufacturer, containing all the components necessary for the complete appliance; or

c) a number of components specified by the appliance manufacturer as necessary to make the complete appliance, some of which come direct from other than the appliance manufacturer,

comprising as relevant:

i) primary heat and power generator;

ii) supplementary heat generator;

iii) combustion air supply and product evacuation ducts;

iv) thermal store.

3.12.2 combination micro-cogeneration appliance
category of micro-cogeneration appliance providing space and water heating, in which the domestic hot water (DHW) service is provided wholly from within the appliance

NOTE Provision of the DHW may utilize either a DHW storage tank or heat exchange coils within the appliance.

3.12.3 condensing micro-cogeneration appliance
micro-cogeneration appliance designed to make use of the latent heat released by the condensation of water vapour in the products of combustion and to allow the condensate to leave the appliance in liquid phase

NOTE Appliances not so designed or without the means to remove the condensate in liquid phase are non-condensing micro-cogeneration appliances.

3.12.4 heating only micro-cogeneration appliance
category of micro-cogeneration appliance providing space heating only (no DHW service)

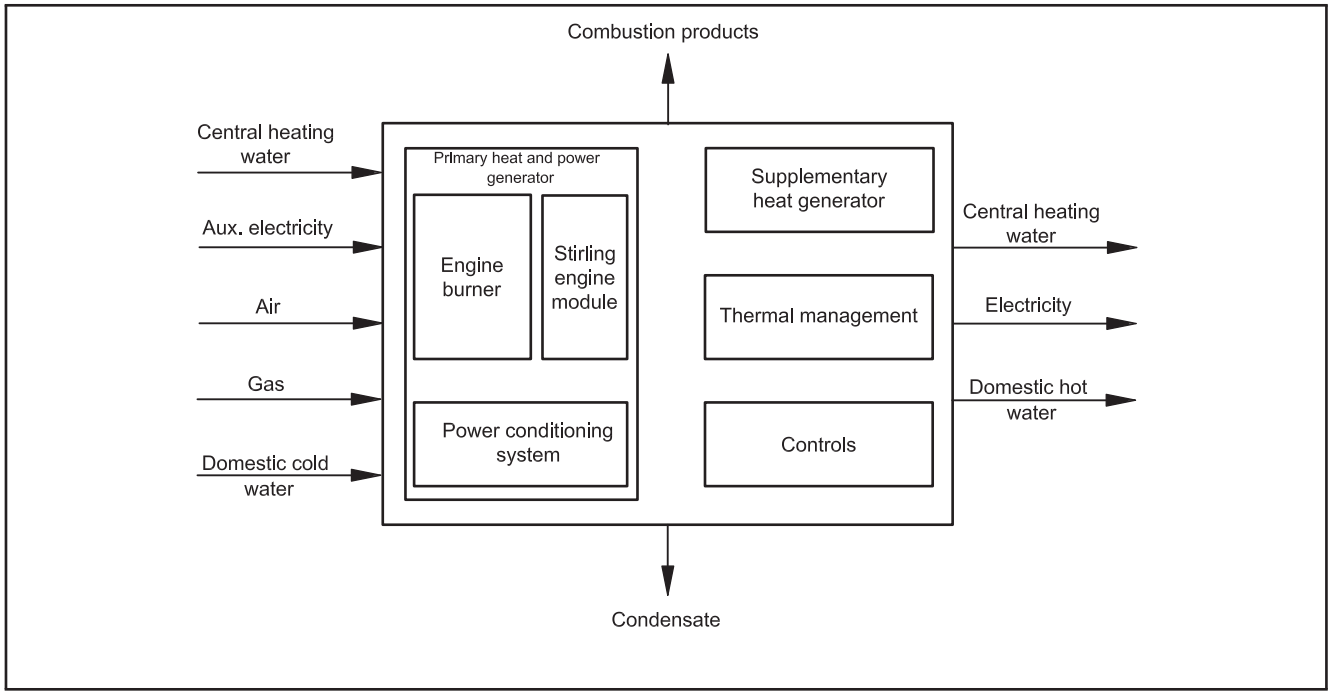
3.12.5 indirect hot water micro-cogeneration appliance
category of micro-cogeneration appliance providing space and water heating, intended for connection to a separate DHW storage vessel or thermal store

*NOTE The DHW storage vessel or thermal store is not part of the appliance, but is connected to it (see Commentary on **6.5**).*

3.12.6 Stirling engine micro-cogeneration appliance
micro-cogeneration appliance that includes a Stirling engine module which thermodynamically converts a proportion of absorbed thermal energy to electrical energy, the remaining energy being transferred to the thermal management system

NOTE See Figure 1 for a diagrammatic description of a typical Stirling engine micro-cogeneration appliance and Annex A for further information on how a Stirling engine micro-cogeneration appliance works.

Figure 1 **Typical set-up for a Stirling engine micro-cogeneration appliance**



3.13 micro-cogeneration appliance compartment
enclosure specifically designed or adapted to house one or more micro-cogeneration appliances, and which is not a habitable space

3.14 open system
heating system which is open to the atmosphere and incorporates a feed and expansion cistern

3.15 operative
person who installs, inspects, commissions, services or maintains a gas-fired micro-cogeneration appliance

*NOTE See Clause **4**.*

3.16 pluming
visible cloud formed when products of combustion exit from a chimney and are cooled below the dew point by mixing with external air

3.17 plume management kit
chimney component designed to manage the discharge of the products of combustion such that any plume will not cause a nuisance

3.18 power conditioning system
equipment used to change electrical voltage level or waveform, or otherwise alter or regulate the electrical output of the primary heat source, to make it suitable and safe for export to other components within or outside the appliance

NOTE The output of the power conditioning system is the point of measurement for the amount and quality of the produced electricity.

3.19 pressure-relief valve
pressure actuated valve which opens automatically at a pre-set pressure to discharge fluid

3.20 primary heat source
preferential heat generator producing electricity

NOTE That is, a Stirling engine micro-cogeneration appliance.

3.21 rated output
useful heat or electrical output declared by the manufacturer

3.22 residual current device
RCD
mechanical switching device or association of devices intended to cause the opening of contacts when the residual current attains a given value under specified conditions

3.23 residual current operated circuit-breaker with integral overcurrent protection
RCBO
residual current operated switching device designed to perform the functions of protection against overload and/or short-circuit

3.24 room-sealed micro-cogeneration appliance
micro-cogeneration appliance whose combustion system is sealed from the room in which the appliance is located and which obtains air for combustion from a ventilated uninhabited space within the premises, or from the open air outside the premises, and vents the products of combustion directly to open air outside the premises

NOTE This type of appliance is designated as Type C in PD CEN/TR 1749.

3.25 sealed system
central heating system incorporating a water circuit that is not open to the atmosphere

3.26 supplementary heat source
non-preferential heat generator providing for high demand

NOTE For example, an auxiliary burner.

3.27 terminal
fitting installed at the outlet of a chimney

NOTE A terminal is fitted to assist products of combustion to escape, minimize downdraught and prevent entry of material which might block the flue.

3.28 thermal management
internal system that manages the transfer of the thermal energy of the micro-cogeneration appliance to a heat transfer fluid circulating in a distribution system to which a heat exchanging system(s) is connected that is equipped to transfer the thermal energy into space heating or space heating and DHW

NOTE The heat exchanging system(s) may include a thermal store.

3.29 thermal store
heating reservoir sited mainly in heated water as opposed to the domestic hot water storage in the DHW reservoir

4 Competence

Persons carrying out work that will have an impact on work covered by the scope of this standard shall ensure that they have the competence relevant for the task such as not to compromise the requirements/recommendations of this standard and, in particular, the safe installation, commissioning and operation of gas equipment.

*COMMENTARY ON **4***

Competence requires sufficient knowledge, practical skill and experience to carry out the job in hand safely, with due regard to good working practice. The installation should also be left in a safe condition for use. Knowledge should be kept up-to-date with changes in law, technology and safe working practice.

There are five principal aspects to competence for micro-cogeneration appliances; these are:

a) knowledge of the relevant Building Regulations [6,7,8,9] for domestic premises;

b) ability to ensure that electrical work in dwellings is designed, installed, inspected and tested to the standard required by BS 7671;

c) knowledge of the Electrical Safety, Quality and Continuity Regulations 2002 [11], particularly Regulation 22 and the exemption in Regulation 22(2);

d) knowledge of Engineering Recommendation G83/1/1;

e) for "gas work", registration with an appropriate authority.

For electrical work [item d)] associated with the connection of a micro-cogeneration appliance to a distributing main, a competent person is one who has sufficient skills and training to apply safe methods of work in compliance with the requirements of Engineering Recommendation G83/1/1.

It is a statutory requirement in Great Britain, Isle of Man, Northern Ireland and Guernsey (see Table 1) that all "gas work" [item e)] be carried out by a business or self-employed person(s) that is a member of a "class of persons" registered with a registration body which has been approved by an approval body (see Table 1) to operate and maintain such a register.

At the time of publication, the only body with approval to operate and maintain a register of individuals/businesses who are "members of a class of persons" is the Gas Safe Register. Thus, it is essential that all businesses or self-employed gas engineers are registered with the Gas Safe Register.

The qualifications which persons need to have to be deemed competent to carry out gas work are given in Table 2.

Table 1 **Approval bodies and statutory regulations by country/territory**

Country/ territory	Approval body	Statutory regulations
Great Britain	Health and Safety Executive (HSE)	Gas Safety (Installation and Use) Regulations 1998 [1]
Isle of Man	Health and Safety at Work Inspectorate (HSWI)	Gas Safety (Installation and Use) Regulations 1994, as amended and applied by the Gas Safety (Application) (Isle of Man) Order 1996 [2]
Northern Ireland	Health and Safety Executive Northern Ireland (HSENI)	Gas Safety (Installation and Use) Regulations(Northern Ireland) 2004 [3]
Guernsey	Health and Safety Executive for the States of Guernsey [HSE (Guernsey)]	Health and Safety (Gas) (Guernsey) Ordinance 2006 [4]

Table 2 **Competence requirements by country/territory**

Qualifications	Great Britain and Isle of Man	Northern Ireland	Guernsey
Current certificate(s) of competence in the type of gas work to be conducted, issued by an awarding body accredited by the United Kingdom Accreditation Service (UKAS) (ACS certification)	✓	✓	✓
National/Scottish Vocational Qualification (N/SVQ accredited by Ofqual), which is aligned in matters of gas safety	✓	✓	✓
National/Scottish Vocational Qualification (N/SVQ accredited by Ofqual), which is aligned under the HSC ACoP arrangement [A)] as approved with the registration body	✓	✓	✘
Any other scheme recognized by the gas registration body for registration purposes	✓	✓	✓

[A)] Guidance on the individual competence required for gas work is given in the Health and Safety Commission's Approved Code of Practice (ACoP) (COP 20) "Standards of training in safe gas installation" [14].

5 Environmental considerations

As part of the planning process, consideration shall be given to the following.

a) Disposal/recycling of existing appliances and systems materials that are to be removed.

b) Disposal/recycling of new appliance and system components packaging.

c) Minimization of energy usage through appliance selection (see **6.2.1**).

d) Minimization of harmful emissions discharge (see **6.3.2** and **6.3.4**).

6 Selection of equipment and pre-installation

6.1 Exchange of information and planning

Both for a first-time installation in a new dwelling and when replacing a boiler in an existing heating system, those concerned with the selection of the appropriate micro-cogeneration appliance and the design of the system shall:

a) be aware of the standards and regulations that govern how the installer carries out the installation;

b) collaborate with the installer, both at the planning stage and during the execution of the work;

c) collaborate with the customer regarding notifying the electricity supplier of

the installation of the appliance and the provision of a suitable meter [see item e) under "Consultation with official bodies" in the Commentary on **6.1**);

d) collaborate with the customer and the installer over the location of the micro-cogeneration appliance (see **6.3.2**);

e) be aware that a Stirling engine micro-cogeneration appliance is not to be installed where the electrical supply is controlled by a prepayment meter [see **6.6**a) and b)].

*COMMENTARY ON **6.1***

In the United Kingdom there is a legal requirement (under the Electrical Safety, Quality and Continuity Regulations [11]) for the installer to notify the DNO at or before the time of the installation of the micro-cogeneration appliance (referred to as "inform and fit").

Engineering Recommendation G83/1/1 explains the "inform and fit" procedure and contains recommendations on the procedures to follow regarding discussions with the DNO in the case of single installation and multiple/planned connections.

A single installation is the installation of a single micro-cogeneration appliance in a single customer's installation; multiple/planned installation is a planned installation project where the proposal is to install multiple micro-cogeneration appliances in a close geographical region.

Particular matters that should be considered when carrying out new or replacement installations are:

Consultation with official bodies

The following official bodies might need to be consulted for the reasons given.

a) The local authority, about building regulations and planning application requirements.

b) The fire authority, to establish compliance with relevant fire precautionary requirements, and the fire insurers, for notification of any proposed changes in the means of heating.

c) The Health and Safety Executive (HSE), to establish compliance with health and safety requirements in commercial premises, particularly with regard to safety requirements which are not fulfilled as an integral part of the installation.

d) The water authority/company, about the requirements of the Water Supply (Water Fittings) Regulations, as amended [10], or relevant by-laws.

e) The electricity supplier (to be contacted by the customer) concerning the provision of a new meter for the following reasons:

1) the customer will have a contract with an electricity supplier for the purchase of electricity monitored through a meter;

2) in order for the customer to take full advantage of any "Feed-In Tariffs" available;

NOTE 1 These tariffs reward customers for the energy they generate whether used by the customer or exported back into the network.

3) when the micro-cogeneration appliance generates more electricity than is being used in the premises, the surplus will go back into the mains and the reverse flow of electricity can have an impact on the customer's existing meter as follows:

- *some meters are fitted with a backstop which prevents the energy register from running backwards, so the consumer is exporting electricity but receives no compensation for it;*

- *some meters with a backstop have a flag that is tripped by reverse power flow, which could result in the consumer being accused of stealing energy;*
- *some older meters might not have a backstop so that the register will run backwards while energy is being exported, effectively crediting the consumer with energy at the rate at which they normally pay for the electricity; this could be treated by the electricity supplier as a form of theft.*

Liaison between the various trades

Liaison between the various trades carrying out the work is essential for a safe and efficient installation, in particular to ensure:

a) *the availability and suitability of gas (see **7.5**), electrical (see **6.6** and **7.6**) and water supplies (see **7.7**);*

b) *the means of isolation (see **7.6.6**), earthing (see **7.6.3** or **7.6.4**, as appropriate) and safety labels (see **7.6.7**) are present;*

c) *provision of forms used to notify the DNO that a micro-cogeneration appliance has been installed;*

NOTE 2 Appendices 1, 2, and 3 of Engineering Recommendation G83/1/1 provide respectively:

- *connection ("inform and fit") procedure flow chart;*
- *application form to a DNO for connection;*
- *micro-cogeneration appliance form for confirmation of installation and commissioning;*

d) *that mains wiring external to the micro-cogeneration appliance conforms to BS 7671 and any local regulations;*

e) *connection to the mains is made in accordance with the latest edition of Engineering Recommendation G83/1/1;*

f) *the heat requirements (see **6.2.1** and **6.5**);*

g) *the compatibility of heat emitters with current needs;*

h) *the physical size, design and position of the micro-cogeneration appliance, and its relationship to structural support, noise (see **7.3.12**) and vibration control, and combustible materials;*

NOTE 3 Some installations will involve preliminary structural work which needs to be completed at the building carcass stage. Suitable bases are required for floor-standing appliances.

i) *the type of building, form of construction (e.g. timber framed), and the probable position of fixtures, furniture and curtains;*

NOTE 4 Information on gas installations in timber-framed and light steel-framed buildings is given in IGE/UP/7, Edition 2.

NOTE 5 Information on gas installations in flats and other multi-dwelling buildings is given in IGE/G/5.

j) *the size, height, type, support and route of the chimney and the position of the chimney outlet, including the possible consequences of any pluming; particular notice is drawn to the advice in:*

- *BS 5440-1 on the connection to SE-duct, U-duct and shared chimneys;*
- *Technical Bulletin 008 [15], as published by Gas Safe Register, concerning the requirement in the Gas Safety (Installation and Use) Regulations [1] that flues are examined prior to initial commissioning of the appliance and during routine servicing or maintenance of the appliance;*

k) the position of any drains for condensate or pressure/temperature-relief valve discharge;

l) the manufacturer's instructions regarding water hardness; unless the manufacturer's instructions say otherwise, where the mains water total hardness (as $CaCO_3$) exceeds 200 ppm, provisions should be made to treat the feed water to the hot water circuit of combination appliances to reduce the rate of accumulation of limescale;

*m) the compatibility of the micro-cogeneration appliance with any system controls (see **7.8**);*

*n) the system controls for energy conservation and comfort, in particular to avoid unnecessary cycling of the micro-cogeneration appliance and to conform to the Building Regulations (see Foreword and **7.8**);*

o) in a replacement situation whether the pump is adequate for the new appliance and is located so as to avoid entrainment of air or discharge of water from the system;

p) whether the system pipework is adequately sized;

*q) the need for the central heating system to be thoroughly cleansed and flushed out before installing a new appliance (see **7.7.4**).*

6.2 Selection of micro-cogeneration appliance

6.2.1 General

Any micro-cogeneration appliance (new or previously used) selected for installation shall carry a CE mark.

The micro-cogeneration appliance shall only be connected to and supplied with the gas for which it was designed.

Conversion to another gas, if necessary, shall be carried out strictly in accordance with the micro-cogeneration appliance manufacturer's instructions, using the manufacturer's supplied kit of parts.

The micro-cogeneration appliance shall only be connected to external control devices approved by the micro-cogeneration appliance manufacturer.

The micro-cogeneration appliance shall be matched to the heat load of the property in accordance with the manufacturer's instructions (see Annex B).

*COMMENTARY ON **6.2.1***

For selection of a gas-fired micro-cogeneration appliance in England, Wales and Northern Ireland attention is drawn to The DCLG publication, Domestic Building Services Compliance Guide – Compliance with Approved Documents L1A:New dwellings and L1B:Existing dwellings *[16]; in particular Section 13,* Micro-combined heat and power systems (micro-CHP).

For selection of a gas-fired micro-cogeneration appliance in Scotland, attention is also drawn to the Building (Scotland) Regulations 2004 Domestic Technical Handbook*, Section 6 (Energy) [17].*

Similar requirements might apply in other areas of the UK.

The HSE publication, Safety in the installation and use of gas systems and appliances *[18] should also be consulted.*

The installer should ensure that the micro-cogeneration appliance carries the CE mark on the data plate and that the data plate and the packaging are marked with at least the following information:

a) the letters "GB";

b) the type of gas and the pressure of utilization indicated as follows:

1) *"G20 and/or natural gas 20 mbar" for a micro-cogeneration appliance adjusted for natural gas;*

2) *"G31 and/or propane 37 mbar" for a micro-cogeneration appliance adjusted for propane;*

3) *"G30 and/or butane 29 mbar" for a micro-cogeneration appliance adjusted for butane;*

4) *"G30, G31 and/or butane/propane 29/37 mbar" for a micro-cogeneration appliance which will burn either butane or propane at the correct pressure.*

The data plate of a CE-marked micro-cogeneration appliance will carry the designation I2H, I3P, I3B, or I3+, respectively, for items 1), 2), 3) or 4). Where a micro-cogeneration appliance data plate carries the letters "Cat II" or "II", followed by the gas type designations P, B, then the micro-cogeneration appliance can be used for propane or butane when adjusted and converted to do so.

If there is any doubt as to the suitability of a micro-cogeneration appliance for a particular gas, the manufacturer should be consulted.

CE marking of a micro-cogeneration appliance in terms of electrical aspects signifies:

- *a declaration by the manufacturer of compliance with the Electrical Equipment (Safety) Regulations 1994 [12] and the Electromagnetic Compatibility Regulations 2006 [13];*
- *that the appliance will be satisfactory in an installation in terms of the power factor, generation of harmonics, and voltage distribution arising from starting current and synchronization;*
- *that the synchronizing system is automatic and of a type that considers frequency, phase and voltage magnitude;*
- *that the manufacturer can produce documentation confirming the acceptability of the means of protection against operation in the event of loss of the mains supply as required by G83/1/1 or BS EN 50438.*

The operative should check the data provided with the micro-cogeneration appliance to confirm that the micro-cogeneration appliance is appropriate for the installation, and should confirm the basis on which the heat input rating is quoted, i.e. gross or net. The ratio of gross to net heat input is approximately 1.11:1 for natural gas, 1.09:1 for propane and 1.08:1 for butane.

Further information on the labelling of gas appliances is given in DD 221:1997.

6.2.2 Micro-cogeneration appliances for sealed systems

Micro-cogeneration appliances intended to be used in a sealed system shall be selected from those specifically designated for this purpose by the manufacturer.

*COMMENTARY ON **6.2.2***

Micro-cogeneration appliances used in sealed systems should incorporate appropriate protection devices.

6.3 Condensing micro-cogeneration appliances

6.3.1 General

Micro-cogeneration appliances designed to be used in the condensing mode shall be installed in accordance with the manufacturer's installation instructions, or, if there are no specific instructions, in accordance with **6.3.2**, **6.3.3**, **6.3.4**, **6.3.5, 6.3.6** and **6.4**.

*COMMENTARY ON **6.3.1***

The manufacturer's installation instructions might contain particular requirements for the condensing micro-cogeneration appliance, e.g. a means for disposal of condensate, the air-gas ratio valve setting and the water temperature operating range.

6.3.2 Location

6.3.2.1 General

The following issues shall be considered when determining the suitability of a particular location:

a) access to the condensate discharge termination for the condensate drainage pipe (see **6.3.3**);

b) chimney outlet location (see **6.3.4**);

c) air supply and ambient conditions (see **7.1** and **7.3.11**, respectively);

d) ventilation (see **7.1** and **7.3.2.3**);

e) space, both for installation and subsequent service access (see **7.3.1**);

f) operating noise (see **7.3.12**);

g) support for the installed weight of the appliance (see **7.3.1** and the final paragraph of the Commentary on **7.3.12**);

h) specific requirements for the appliance siting position chosen (see **7.3.2** to **7.3.10** inclusive).

*COMMENTARY ON **6.3.2.1***

*Room-sealed micro-cogeneration appliances may be installed in any room or space. It is not recommended that any type of micro-cogeneration appliance be installed in an under-stairs cupboard, bathroom or shower-room, bedroom or bed-sitting room, or within a toilet or cloakroom, but such installations are acceptable subject to the requirements of **7.3.4** to **7.3.7**.*

BS 6400, Parts 1 to 3, refers to separation distances and guarding between gas and electric services.

Where a micro-cogeneration appliance is located in an exposed position, such as an external location, roof space or an unheated garage, consideration should be given to frost protection.

There is no restriction on the type of micro-cogeneration appliance that can be installed in a private garage, except where the manufacturer states otherwise. Great care is required in the location of a micro-cogeneration appliance in any premises where concentrations of flammable vapour could accumulate, e.g. commercial garages and associated workshops.

6.3.2.2 3rd family gases

A micro-cogeneration appliance for use with 3rd family gases shall not be installed in a room or internal space situated below ground level, e.g. a basement or cellar.

*COMMENTARY ON **6.3.2.2***

This does not preclude the installation of such appliances in rooms which are basements with respect to one side of the building but open to ground level on the opposite side.

6.3.3 Selection of condensate discharge point

The possibility of the condensate drainage pipe freezing downstream of the connection point to the micro-cogeneration appliance during prolonged spells of extremely cold weather shall be considered when choosing the siting of the condensate discharge point.

Wherever possible, the condensate drainage pipe shall be terminated at an internal foul water discharge point (see **6.3.6.2**).

Where gravity discharge to an internal foul water discharge point is not possible, e.g. the discharge point is above the micro-cogeneration appliance location, or access is obstructed by a doorway, consideration shall be given to the use of a proprietary condensate pump of a specification recommended by the micro-cogeneration appliance or pump manufacturer.

Where gravity or pump discharge to an internal foul water discharge is not possible due to impractical very long pipe runs being required to reach a suitable internal discharge point, an external discharge point can be used (see **6.3.6.3**)

*COMMENTARY ON **6.3.3***

Winters in the UK can experience prolonged spells of extremely cold weather – down to minus 20 °C in many areas. This can cause freezing of the condensate in the condensate discharge pipe causing the pipe to become blocked with ice and the micro-cogeneration appliance to shut down. Whilst there can never be a guarantee (under widespread and prolonged very low temperatures) that the condensate discharge will not freeze, parts of the condensate discharge pipe that are located externally are particularly at risk of freezing; hence the recommendation to use an internal foul water discharge point wherever possible.

A slightly longer pipe run, for example, to an internal soil stack, can be preferable to a shorter run connecting into a kitchen waste pipe discharging directly through the wall to an external drain.

Examples of where a condensate pump can provide solutions are where a micro-cogeneration appliance is to be installed in a basement or below ground level or conversely on an internal wall or in an airing cupboard. Manufacturers of condensate pumps will be able to provide detailed suggestions for the optimum disposal routes.

6.3.4 The siting of the chimney outlet

NOTE Chimney outlet was originally referred to as "terminal" in UK standards.

Where it is considered that the plume from a chimney outlet might cause a nuisance to the user of the appliance or a neighbour, reference shall be made to the micro-cogeneration appliance manufacturer's instructions for specialist advice on how to redirect the chimney outlet, for example by the:

a) partial rotation of the chimney terminal;

b) fitting of a deflector elbow;

c) use of a kit that provides high level termination.

In particular, the potential for the plume to cross the following shall be avoided:

1) a public footpath;

2) a frequently used access route;

3) a frequently used area (such as a patio);

4) a neighbouring dwelling.

The terminal shall not be directed towards a window or door, or be sited close to a facing wall, boundary fence or neighbouring property.

*COMMENTARY ON **6.3.4***

Condensing micro-cogeneration appliances produce a visible plume of water vapour for a significant proportion of their operating time. At low level, this plume could cause nuisance.

Other aspects to consider when planning the chimney outlet position include the following.

a) *A free passage of air is needed to aid plume dispersal.*

b) *The section on flue terminal siting in the DCLG publication,* Guide to the condensing boiler installation assessment procedure for dwellings *[19], that advises against the positioning of the flue termination of a condensing appliance under a carport.*

c) *In cold weather, the plume could cause a safety hazard if it freezes on pathways, or if it results in frost damage to surfaces.*

d) *The plume could trigger infra-red security lighting if sited in the wrong place.*

e) *The plume could affect the performance of external temperature sensors associated with energy management control systems.*

f) *The chimney outlet or plume should not obscure security camera field of vision.*

g) *The chimney outlet guards should be able to resist corrosive properties of the condensate.*

h) *The need for a plume management kit when provided or specified by the micro-cogeneration appliance manufacturer.*

i) *Some micro-cogeneration appliances might be designed to disperse condensate in a spray form within the combustion products discharge. With these types of micro-cogeneration appliance particular care is necessary when siting the terminal to ensure safe disposal of the condensate in accordance with the manufacturer's instructions.*

Further information on chimney outlet siting and plume management is provided in BS 5440-1. Guidance on how to reduce the possibility of nuisance to neighbouring buildings, can be obtained from the section on flue terminal siting in the DCLG publication, Guide to the condensing boiler installation assessment procedure for dwellings *[19].*

6.3.5 The choice of condensate drainage pipe

6.3.5.1 Material

The condensate drainage pipe shall be run in a standard drainpipe material, e.g. poly(vinyl chloride) (PVC), unplasticized poly(vinyl chloride) (PVC-U), acrylonitrilebutadiene-styrene (ABS), polypropylene (PP) or chlorinated poly(vinyl chloride) (PVC-C).

6.3.5.2 Diameter of internally run condensate pipe

The condensate drainage pipe connected to the condensate drain outlet on the micro-cogeneration appliance shall have a minimum internal diameter (ID) of 19 mm, or as recommended by the micro-cogeneration appliance manufacturer, to promote the clearance of condensate.

*COMMENTARY ON **6.3.5.2***

Historically, the outside diameter (OD) has been used to specify the size of condensate pipe required as this automatically delivered the internal diameter (ID) considered necessary to aid efficient disposal of the condensate. With the advent of European Standards, plastic pipe manufacturers can now choose to manufacture to a variety of ODs and wall thicknesses, yet the minimum ID requirement to aid efficient disposal of the condensate remains. Hence the minimum ID is now specified as the requirement, providing the maximum flexibility of choice for the installer.

6.3.5.3 Diameter of externally run condensate pipe

Any external condensate drainage pipe shall be increased to a minimum of 30 mm ID to reduce the risk of freezing.

*COMMENTARY ON **6.3.5.3***

When a micro-cogeneration appliance is to be installed in an unheated location, e.g. a loft, basement or garage, all condensate drainage pipes downstream from the trap or siphon should be considered as external.

Historically, the outside diameter (OD) has been used to specify the size of condensate pipe required as this automatically delivered the internal diameter (ID) considered necessary to aid efficient disposal of the condensate. With the advent of European Standards, plastic pipe manufacturers can now choose to manufacture to a variety of ODs and wall thicknesses, yet the minimum ID requirement to aid efficient disposal of the condensate remains. Hence the minimum ID is now specified as the requirement, providing the maximum flexibility of choice for the installer.

6.3.6 The positioning and termination of the condensate drainage pipe

6.3.6.1 General

The condensate drainage pipe shall be positioned and terminated such that it discharges the condensate safely away from the building.

All internal condensate drainage pipes and connecting pipework operating under gravity shall have a fall of at least 2.5° to the horizontal or approximately 45 mm per metre of condensate drainage pipe run away from the micro-cogeneration appliance. The number of bends and fittings shall be kept to a minimum in order to reduce the risk of condensate being trapped.

Suitable condensate discharge arrangements shall be provided by connection to:

a) a soil and vent stack, internal (see **6.3.6.2**) and external (see **6.3.6.3.3**);

b) an internal waste pipe (see **6.3.6.3.2** and **6.3.6.3.1**);

c) an external drain or gully, which discharges into a foul water system and does not discharge into a surface water or storm drain (see **6.3.6.3.4** and **6.3.6.3.1**);

d) a rainwater hopper that is part of a combined system, i.e. a sewer that carries both foul water and rainwater (see **6.3.6.3.4** and **6.3.6.3.1**);

   NOTE 1 Further information on the identification of a combined system can be obtained from the local water undertaker.

e) a rainwater downpipe (see **6.3.6.3.5**);

f) a purpose-made soakaway (see **6.3.6.3.6** and **6.3.6.3.1**) if none of the condensate discharge arrangements in a) to e) are practicable.

NOTE 2 Where the condensate is, by design, discharged with the combustion products from the chimney outlet of the micro-cogeneration appliance, the manufacturer's instructions will contain advice regarding the siting of the chimney outlet to ensure safe disposal of the condensate.

*COMMENTARY ON **6.3.6.1***

Internal discharge points are strongly recommended as they are less likely to become blocked by, for example, leaves or frozen condensate.

It should be noted that the connection of a condensate drainage pipe to a drain might be subject to local building controls.

The condensate drainage pipe should be supported at a maximum spacing of 0.5 m for near horizontal sections and 1.0 m for vertical sections.

In some circumstances it is permissible to connect the condensate drain to either a treatment plant (i.e. a digester), a septic tank or a cesspit; however, this should not be undertaken unless the person responsible for the sewerage system has confirmed that it will not adversely impact on the system. To make this assessment, the person responsible will need to know the typical condensate discharge conditions, e.g. the amount of acidulated condensate produced per day, the pH of the condensate and the proportion that the condensate is of the total flow going to the treatment plant, septic tank or cesspit.

6.3.6.2 Connection to an internal soil and vent stack system (Figure 2), i.e. an internal foul water discharge point

*NOTE 1 Provided the condensate drainage pipe conforms to **6.3.5**, there is no length restriction.*

The condensate drainage pipe shall incorporate a trap with a minimum condensate seal of 75 mm. Many condensing micro-cogeneration appliances incorporate a condensate trap within the micro-cogeneration appliance; if this condensate trap has a condensate seal of less than 75 mm, then an additional trap of 75 mm shall be fitted with a visible air break between the micro-cogeneration appliance and the additional trap.

The condensate drainage pipe shall not discharge into the internal soil and vent stack lower than 450 mm above the invert of the tail of the bend at the foot of the stack for single dwellings of up to three storeys. If this is not visible then the height shall be measured from the lowest straight section of the stack that is visible.

For multi-storey buildings this distance shall be increased as follows:

a) for up to and including five storeys, the condensate drainage pipe shall not discharge into the internal soil and vent stack less than 750 mm above the invert of the tail of the bend at the foot of the stack;

b) for more than five storeys but not more than 20 storeys, ground-floor appliances shall discharge into their own internal soil and vent stack or discharge directly to an external drain, gully or rainwater hopper;

c) for more than 20 storeys, the ground-floor and first-floor appliances shall discharge into their own internal soil and vent stack or directly to an external drain, gully or rainwater hopper.

The connection to the internal soil and vent stack shall not be made in a way that could cause cross-flow into any other branch pipe or from that branch pipe into the condensate drainage pipe.

NOTE 2 This can be achieved by maintaining an offset between branch pipes of at least 110 mm on a 100 mm diameter stack and 250 mm on a 150 mm diameter stack.

When connecting into a cast iron internal soil and vent stack, connection shall not be above the highest point of any existing wastewater or into any branch not used for wastewater disposal.

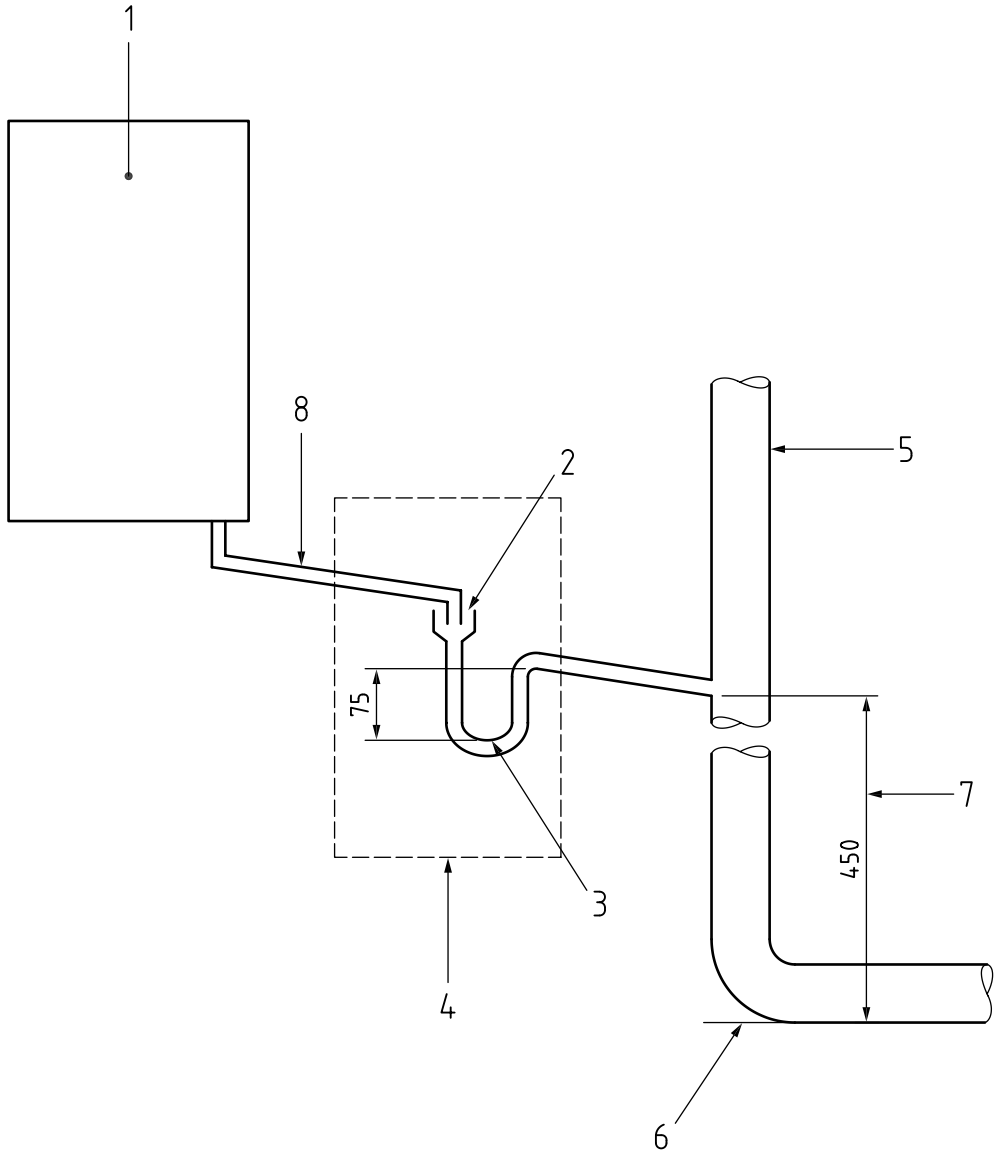
Any parts of the cast iron stack likely to be exposed to the condensate shall either be in a vertical plain, or be of reasonably short length with significant fall to limit the likelihood of concentrations of condensate at any point.

*COMMENTARY ON **6.3.6.2***

A redundant branch where original sanitary appliances have been disconnected is an example of a branch not used for wastewater disposal.

Care should be exercised if any connection to the cast iron waste system involves drilling or cutting the cast iron as older existing cast iron installations can be brittle and prone to shatter.

Figure 2 **Connection of condensate drainage pipe to internal soil and vent stack**



Key

1 Micro-cogeneration appliance
2 Visible air break
3 75 mm trap
4 Visible air break and trap not required if there is a trap with a minimum condensate seal of 75 mm incorporated into the micro-cogeneration appliance
5 Soil and vent stack
6 Invert
7 450 mm minimum up to three storeys
8 Minimum internal diameter 19 mm

6.3.6.3 Connection to an external foul water discharge point

6.3.6.3.1 General

Where an externally foul water discharge point is used the following measures shall be adopted.

a) The pipe shall be run internally as far as possible before going external and the pipe diameter shall be increased to a minimum of 30 mm ID before it passes through the wall. Wherever practicable, for condensate pipe operating under gravity, the fall to the horizontal for the 30 mm ID pipe through the wall shall be greater than the 2.5° required for internal 19 mm ID pipe.

b) The external run shall be kept as short as possible, preferably less than 3 m, taking the most direct and most vertical route possible to the discharge point, with no horizontal sections in which the condensate might collect.

c) The use of fittings, elbows, etc., shall be kept to a minimum and any internal burrs on cut pipework shall be removed to ensure that the internal pipe section is as smooth as possible.

d) To minimize wind chill at the open end of the condensate drainage pipe, the end of the pipe shall:

   1) terminate below the grating and above the water level, and

   2) be covered by a drain cover such as those used to prevent blockage by leaves.

e) To improve drainage the end of the pipe shall be cut at 45°.

f) The pipe shall be insulated from the outside of the external wall of the building (ensuring no gaps between insulation and wall) using suitable waterproof and weatherproof insulation.

g) The owner of the appliance shall be advised that this type of installation is more likely to freeze in prolonged periods of extremely cold weather (see **6.3.3**) resulting in micro-cogeneration appliance shutdown requiring remedial action.

h) Where there are likely to be extremes of temperature or wind-chill, the use of proprietary trace heating systems incorporating an external frost thermostat can be considered ensuring that the installation instructions of the trace heating manufacturer are followed.

*COMMENTARY ON **6.3.6.3.1***

Other cold weather protection methods that are endorsed by the specific micro-cogeneration appliance manufacturer and/or specific service organizations can be adopted if the method adopted is acceptable to the owner of the appliance.

6.3.6.3.2 Connection to an internal waste pipe (Figure 3)

*NOTE 1 Provided the condensate drainage pipe conforms to **6.3.5**, there is no length restriction.*

The connection shall be made to the internal waste pipe from a sink, washing machine, dishwasher, basin, bath or shower, either downstream [Figure 3a)] or upstream [Figure 3b)] of the waste trap.

NOTE 2 If practical, the connection should be made to the upper part of the pipe wall.

If the connection is downstream of the waste trap and the micro-cogeneration appliance does not have an integral condensate trap with a depth of seal of at least 75 mm then an additional trap of at least 75 mm shall be fitted. A visible air break shall be included between the trap in the appliance and the additional trap, as shown in Figure 3a).

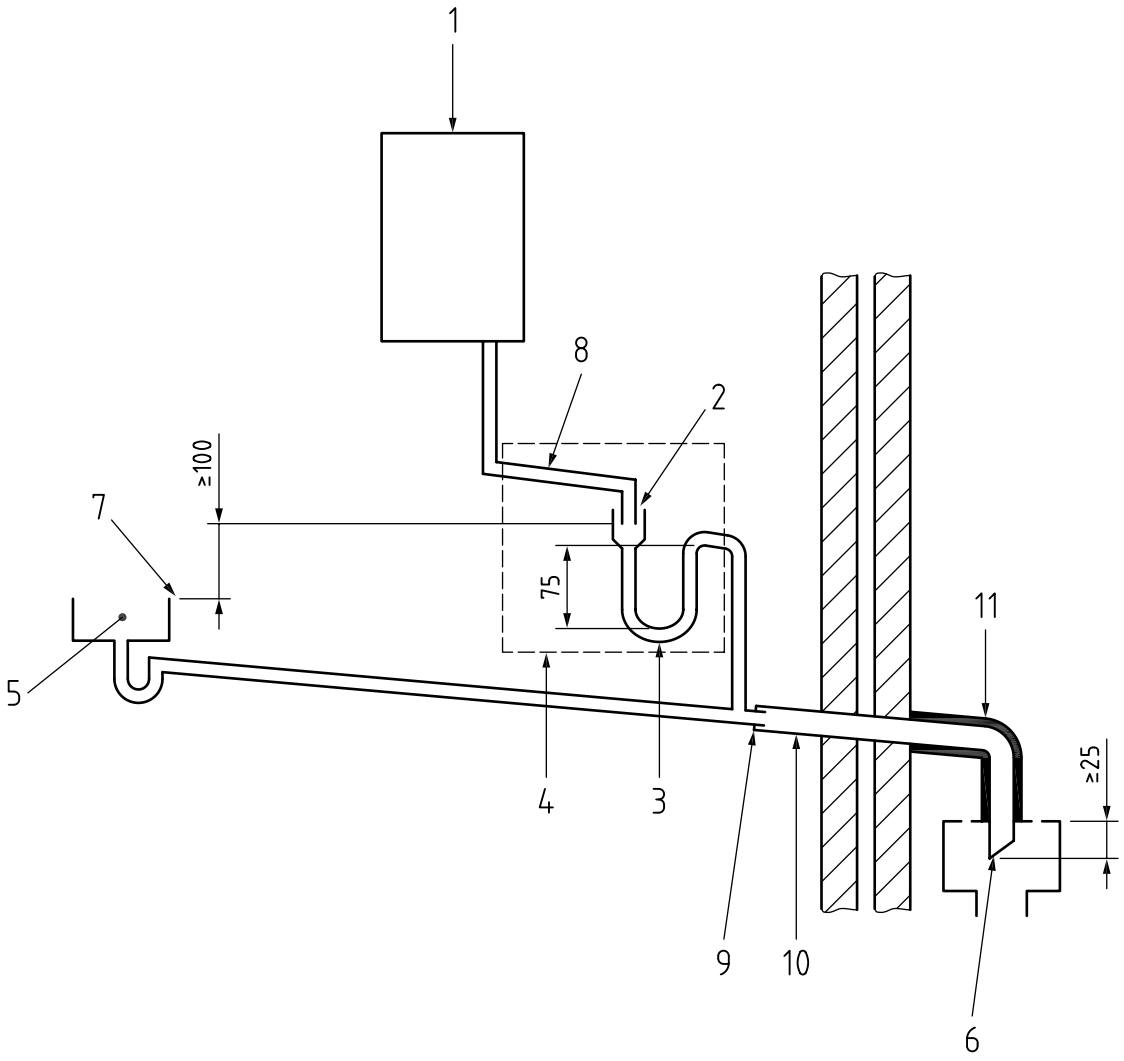
If the connection is upstream of the waste trap, then a visible air break shall be provided between the waste trap and the condensate trap but, in the case of a sink, basin or bath, this is provided by the sink, basin or bath waste pipe itself [see Figure 3b)] as long as the sink, basin or bath has an integral overflow.

In order to prevent waste from a sink, washing machine, dishwasher, basin, bath or shower entering the condensate trap, there shall be a minimum of 100 mm between the visible air break at the lowest condensate trap and the top of the sink, basin, bath or shower tray or visible air break serving the washing machine or dishwasher.

*COMMENTARY ON **6.3.6.3.2***

It is preferable to connect to a washing machine drain rather than a kitchen sink as this reduces the likelihood of solid waste and fats blocking or restricting the drainage of condensate.

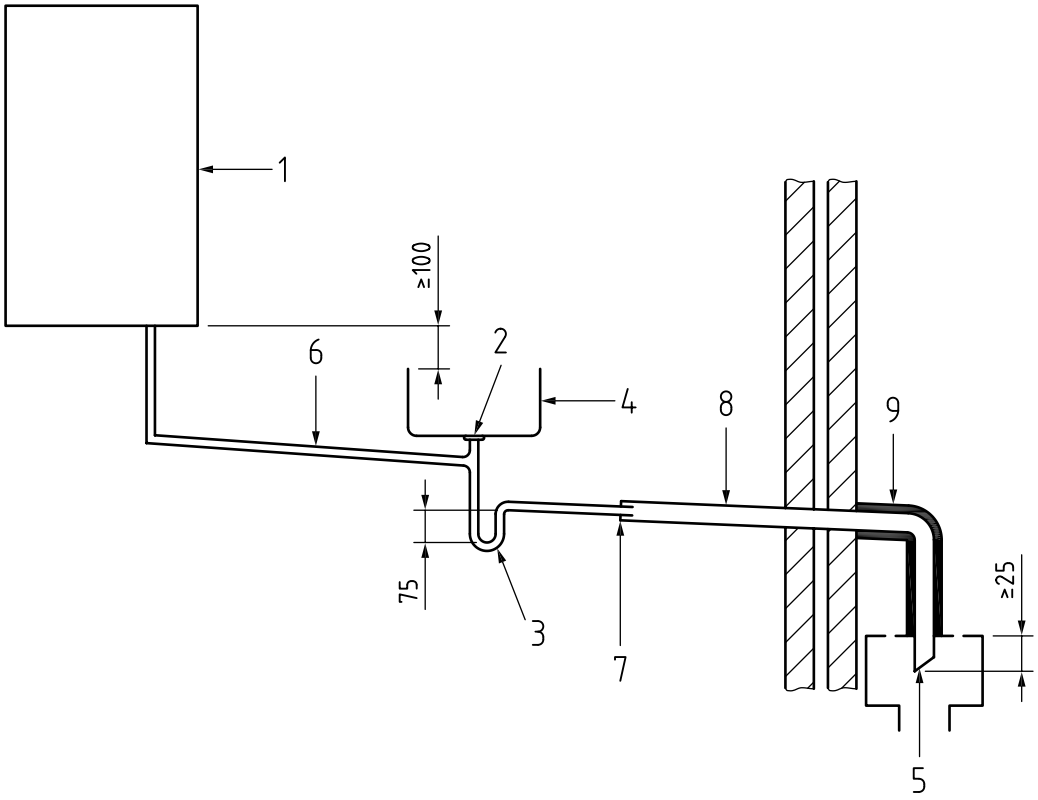
Figure 3a) **Connection of a condensate drainage pipe downstream of a sink, basin, bath or shower waste trap**



Key

1 Micro-cogeneration appliance
2 Visible air break
3 75 mm trap
4 Visible air break and trap not required if there is a trap with a minimum condensate seal of 75 mm incorporated into the micro-cogeneration appliance. In this case the 100 mm is measured to the trap in the micro-cogeneration appliance.
5 Sink, basin, bath or shower
6 Open end of condensate drainage pipe direct into gully 25 mm min below grating but above water level; end cut at 45°
7 Sink lip
8 Minimum internal diameter 19 mm
9 Pipe size transition
10 Minimum internal diameter 30 mm
11 Insulation

Figure 3b) **Connection of a condensate drainage pipe upstream of a sink, basin, bath or shower waste trap**



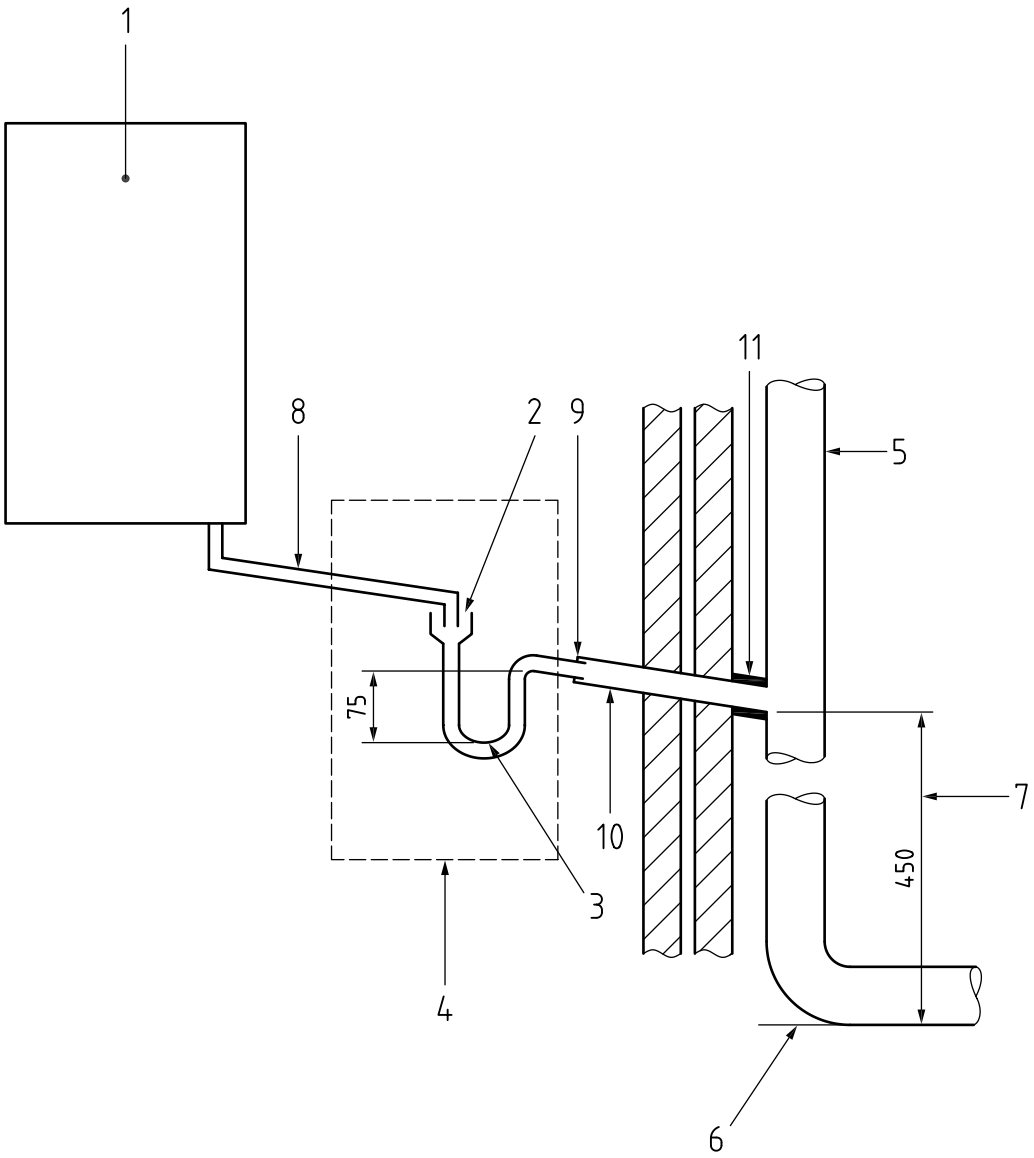
Key

1 Micro-cogeneration appliance
2 Visible air break at plughole
3 75 mm sink, basin, bath or shower waste trap
4 Sink, basin, bath or shower with integral overflow
5 Open end of condensate drainage pipe direct into gully 25 mm min below grating but above water level; end cut at 45°
6 Minimum internal diameter 19 mm
7 Pipe size transition
8 Minimum internal diameter 30 mm
9 Insulation

6.3.6.3.3 Connection to an external soil and vent stack system (Figure 4)

If the termination is to be to an external soil and vent stack, the connection shall conform to **6.3.6.2**, having taken note of and implementing the general requirements for external condensate drainage pipes (see **6.3.6.3.1** and Figure 4).

Figure 4 **Connection of condensate drainage pipe to external soil and vent stack**



Key

1 Micro-cogeneration appliance
2 Visible air break
3 75 mm trap
4 Visible air break and trap not required if there is a trap with a minimum condensate seal of 75 mm incorporated into the micro-cogeneration appliance
5 Soil and vent stack
6 Invert
7 450 mm minimum up to three storeys
8 Minimum internal diameter 19 mm
9 Pipe size transition point
10 Minimum internal diameter 30 mm
11 Insulation

6.3.6.3.4 Connection to an external drain, gully or rainwater hopper (Figure 5)

The open end of the condensate drainage pipe shall be directed into a rainwater hopper or gully.

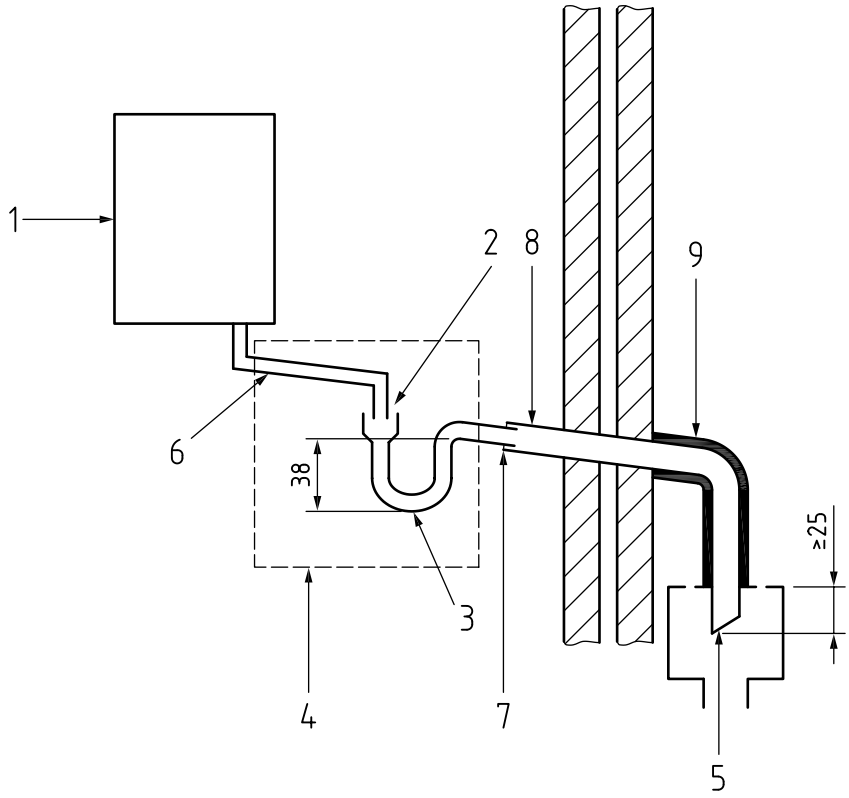
Unless the micro-cogeneration appliance includes a trap of at least 38 mm depth, a trap of at least 38 mm shall be installed between the appliance and the discharge point, with a visible air break between the appliance and the trap.

The rainwater hopper shall be part of a combined system [see **6.3.6.1**d)].

Condensate shall not be disposed of into a greywater recovery system that is intended for reuse.

NOTE Further guidance on greywater recovery systems can be found in the Water Regulations Advisory Scheme (WRAS) publication, Reclaimed Water Systems. Information about Installing, Modifying or Maintaining Reclaimed Water Systems *(No 9-02-04) [20].*

Figure 5 **External drain, gully or rainwater hopper**



Key

1 Micro-cogeneration appliance
2 Visible air break
3 38 mm minimum trap
4 Visible air break and trap not required if there is a trap with a minimum condensate seal of 38 mm incorporated into the micro-cogeneration appliance
5 Open end of condensate drainage pipe direct into gully 25 mm min below grating but above water level; end cut at 45°
6 Minimum internal diameter 19 mm
7 Pipe size transition point
8 Minimum internal diameter 30 mm
9 Insulation

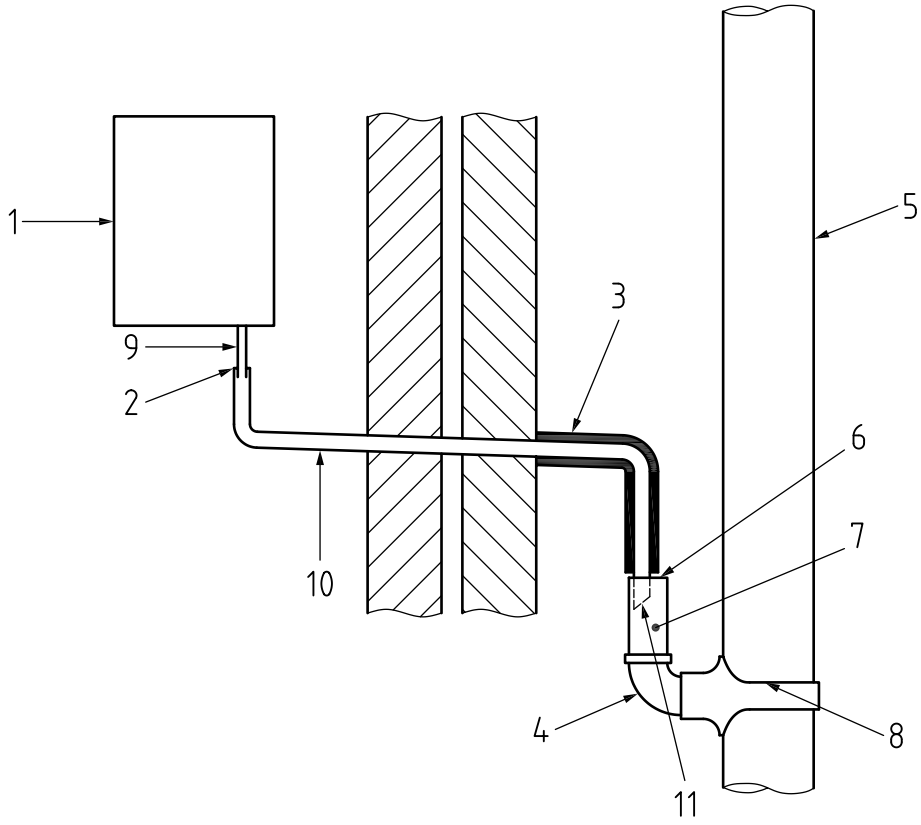
6.3.6.3.5 Special conditions when using a rainwater downpipe (Figure 6)

A rainwater downpipe can only be used for condensate discharge if the downpipe passes to a combined foul and rainwater drainage system and an air break shall be installed between the condensate drainage pipe and the downpipe to avoid reverse flow of rain water into the micro-cogeneration appliance if the downpipe becomes flooded or frozen.

When connecting the condensate pipe into the rainwater downpipe, an appropriate fitting shall be used, i.e. the pipe shall not be pushed directly into the downpipe as this could cause blockage.

Condensate shall not be disposed of into a greywater recovery system that is intended for reuse.

Figure 6 **External termination to rainwater downpipe**



Key

1	Micro-cogeneration appliance	7	Air gap
2	Pipe size transition point	8	68 mm Ø PVCu strap-on fitting
3	Insulation	9	Minimum internal diameter 19 mm
4	43 mm 90° male/female bend	10	Minimum internal diameter 30 mm
5	External rain water pipe into foul water	11	End cut at 45°
6	External air break		

6.3.6.3.6 Connection to a purpose-made soakaway (Figure 7)

A purpose-made soakaway shall be sited in a convenient position as close as possible to the micro-cogeneration appliance, but clear of the building's foundations, ensuring that no other services are in the vicinity to avoid interfering with their functions.

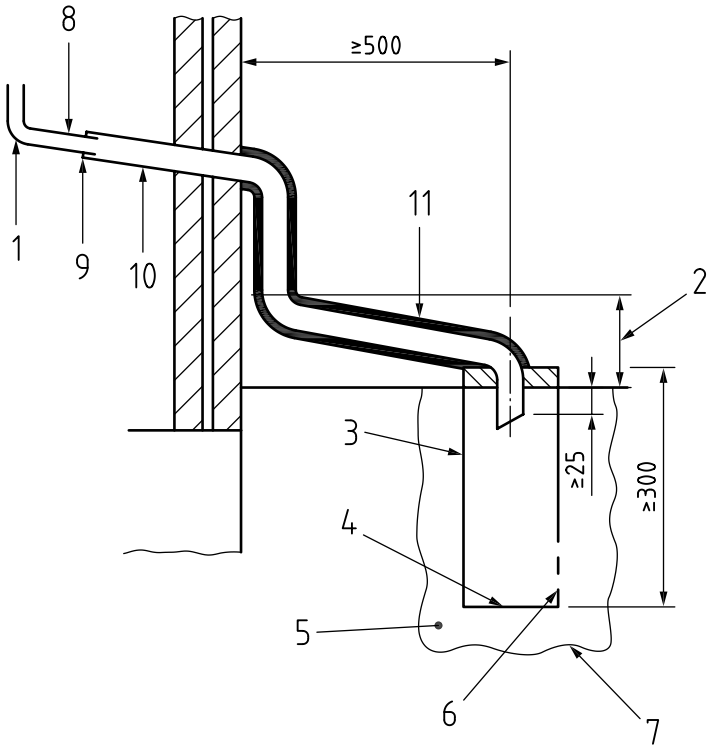
NOTE 1 An example of a suitable design is shown in Figure 7.

Unless the micro-cogeneration appliance includes a trap of at least 38 mm depth, a trap of at least 38 mm shall be installed between the appliance and the discharge point, with a visible air break between the appliance and the trap.

*NOTE 2 For general guidance on external condensate drainage pipes, see **6.3.5.3**.*

If an existing soakaway is to be reused, the limestone chippings in and around the soakaway shall be replaced.

Figure 7 **Example of a purpose-made soakaway**



Key

1 Condensate discharge pipe from micro-cogeneration appliance
2 Ground (this section of the condensate drainage pipe may be run either above or below ground level); end cut at 45°
3 Diameter 100 mm minimum plastic tube
4 Bottom of tube sealed
5 Limestone chippings
6 Two rows of three 12 mm holes at 25 mm centres, 50 mm from bottom of tube and facing away from house
7 Hole depth 400 mm minimum by 300 mm diameter
8 Minimum internal diameter 19 mm
9 Pipe size transition point
10 Minimum internal diameter 30 mm
11 Insulation

6.3.6.3.7 In-line condensate neutralizer devices

An in-line neutralizer device shall only be fitted in the condensate line where the micro-cogeneration appliance manufacturer's installation instructions allow for this. In addition:

a) the flow rate through the device shall be compatible with the condensate flow rate stated by the micro-cogeneration appliance manufacturer's instructions;

b) the installation instructions supplied with the neutralizer device shall include advice on the effective life of the neutralizing agent, temperature limitations and method of replacement;

c) details of this effective life shall be prominently and durably fixed to the outside of the micro-cogeneration appliance casing by the operative and shall clearly state that it is the responsibility of the owner to ensure that a suitable service regime is in place for the neutralizer;

d) the restrictions on condensate drainage pipe material in **6.3.5** and the discharge arrangements specified in **6.3.6** shall continue to apply, unless the system is designed to automatically turn off the micro-cogeneration appliance in the event of the neutralizing agent no longer neutralizing the condensate and requires a qualified operative to restart the micro-cogeneration appliance.

*COMMENTARY ON **6.3.6.3.7***

*Unless the neutralizing device automatically shuts off the micro-cogeneration appliance as described in item d) (because there is no guarantee that the customer will have a suitable service regime in place) then, if the drainage pipe fitted to the outlet of the device is other than specified in **6.3.5**, it is likely the drainage pipe will corrode and perforate and the acidic condensate will be inappropriately discharged.*

6.4 Materials and components

All materials and components used in the installation shall conform to the applicable British or European Standard if such a standard exists.

Materials containing asbestos shall not be used. High-melting-point solders incorporating cadmium shall not be used.

NOTE Attention is drawn to the Water Fittings Regulations [10], which require that materials in contact, or likely to come into contact, with wholesome water (water supplied for such domestic purposes as cooking, drinking, food preparation or washing) do not constitute a toxic hazard, do not contribute to microbiological growth and do not give rise to unpleasant taste or odour, cloudiness or discolouration of the water. For example, solder containing lead is not to be used in pipework conveying water which is required to be wholesome.

*COMMENTARY ON **6.4***

Where no British or European Standard exists, materials and components should be of a suitable quality, and should be designed, constructed and installed to fulfil their intended purpose and so as not to put the safety of persons at risk.

Products for installation in the United Kingdom should be selected from those which have been verified and listed in the Water Fittings and Materials Directory published by the Water Regulations Advisory Scheme (WRAS) (see www.wras.co.uk/directory).

6.5 Selection of heating system configuration

The heating system configuration chosen shall be in accordance with the appliance manufacturer's instructions.

*COMMENTARY ON **6.5***

An indirect hot water micro-cogeneration appliance can be used as part of a conventional heating system featuring a standard domestic hot water (DHW) cylinder or as part of a thermal store based heating system.

Choosing the configuration best suited to the particular property will depend on many factors, e.g. space available for the installation, maximizing the energy saving and environmental benefits of micro-cogeneration, cost, etc., and the manufacturer's instructions should be consulted for their recommendations before making this choice.

6.6 Electrical installation

Prior to commencing the installation of a micro-cogeneration appliance the operative shall:

a) ensure that the electricity supply to the micro-cogeneration appliance is not controlled by a prepayment meter [see **6.1**];

b) if a prepayment meter is in place, make the owner of the property aware that installation of the micro-cogeneration appliance cannot proceed until the meter is replaced with a credit meter;

c) confirm that the existing electrical installation's safety provisions are suitable and adequate for the connection of the micro-cogeneration equipment; and the proposed electrical connection in the premises conforms to BS 7671;

d) encourage the customer to notify their electricity supplier of the installation of a micro-cogeneration appliance [see item e) under "Consultation with official bodies" in Commentary on **6.1**];

e) advise the customer to check with their electricity supplier concerning the costs associated with installing a suitable meter [see item e) under "Consultation with official bodies" in Commentary on **6.1**].

*COMMENTARY ON **6.6**a) and b)*

A prepayment meter is unsuitable for the following reasons.

1) Repeated uncontrolled shut down (e.g. many users only recharge their meter when it has cut off supply) with no provision for electric power to cooling pumps and fans in the micro-cogeneration appliance can cause damage to the appliance.

2) When the micro-cogeneration appliance generates more electricity than is being used in the premises, the surplus will go back into the mains and a prepayment meter could have an internal contactor that cuts off the mains supply if the energy flow is reversed.

*COMMENTARY ON **6.6**c)*

Compliance with BS 7671 can be confirmed by examining a recent Periodic Inspection Report for the existing installation (if available), or by carrying out a Periodic Inspection.

Exemption to the requirement for prior consent of the DNO to fit a micro-cogeneration appliance, contained in Regulation 22(2) of the Electricity Safety, Quality and Continuity Regulations 2002 [11] requires compliance of the existing installation with BS 7671.

6.7 Micro-cogeneration rating

The heat requirements of the system, as agreed between supplier and purchaser, shall be documented. The rated heat output of the micro-cogeneration appliance shall be at least equal to this documented requirement.

*COMMENTARY ON **6.7***

When determining the micro-cogeneration appliance rating, provision should be made for the space heating demand of the building, which depends on how frequently the heating will be used and on the characteristics of the premises (see Annex B).

In a system providing both a space heating and a domestic hot water service, additional heat output might be necessary, the actual amount depending upon the hot-water storage capacity and the pattern of usage.

This is particularly important in low energy housing where the hot water service could take a greater proportion of the total heat requirements. Where system controls give priority to one service, or for some types of combination micro-cogeneration appliance where the heat output is independently controlled for heating and domestic hot water, this additional output is not necessary.

7 Installation

7.1 Air supply for combustion and ventilation

Any micro-cogeneration appliance installed shall have an air supply for combustion and ventilation conforming to BS 5440-2.

*COMMENTARY ON **7.1***

BS 5440-2 specifies the air supply requirements of room-sealed appliances installed in compartments and in rooms.

For premises insulated against external noise (e.g. noise of traffic, aircraft), attention is drawn to local noise insulation regulations.

7.2 Chimney system

The products of combustion shall be conducted to the outside air. The chimney system shall conform to BS 5440-1.

*COMMENTARY ON **7.2***

Information on chimneys for timber-framed and light steel-framed buildings is given in IGE/UP/7, Edition 2.

Information on room-sealed fanned draught flue systems concealed within voids is given in Technical Bulletin 008, as published by Gas Safe Register [15].

7.3 Siting of the appliance

7.3.1 General

The floor or wall on which the micro co-generation appliance is to be installed shall be capable of supporting the weight of the appliance when it is filled with water, and the floor shall be flat and level.

The space around the micro-cogeneration appliance shall be at least the minimum specified in the manufacturer's installation instructions.

The floor or wall on which the micro-cogeneration appliance is to be mounted shall be protected in accordance with the manufacturer's instructions.

*COMMENTARY ON **7.3.1***

The space around the micro-cogeneration appliance should be adequate:

a) to ensure sufficient air for cooling; and

b) for maintenance and servicing.

7.3.2 Micro-cogeneration appliance compartment installations

7.3.2.1 The compartment shall be a fixed rigid structure, the internal surfaces of which conform to the micro-cogeneration appliance manufacturer's installation instructions.

*COMMENTARY ON **7.3.2.1***

If the micro-cogeneration appliance manufacturer's installation instructions do not give specific advice, then any internal surface of the compartment which is of combustible material should either be at least 75 mm from any part of the appliance or should be lined with non-combustible material. Methods of determining whether a material can be described as combustible or non-combustible are given in BS 476-22. For further advice, see HSE publication, Safety in the installation and use of gas systems and appliances *[18].*

7.3.2.2 The compartment shall permit access for inspection and servicing of the micro-cogeneration appliance and any ancillary equipment fitted within the compartment. A notice shall be fixed in a prominent position within the compartment to warn against its use as a storage cupboard. The compartment shall be fitted with a door that will permit withdrawal of the micro-cogeneration appliance and any ancillary equipment.

7.3.2.3 Where necessary, according to the micro-cogeneration appliance manufacturer's instructions, the compartment shall incorporate air vents for cooling.

7.3.3 Airing cupboard installations

7.3.3.1 An airing cupboard adapted to house a micro-cogeneration appliance shall conform to **7.3.2**. Additionally, the airing spaces shall be separated from the micro-cogeneration appliance compartment by a non-combustible partition, which may be perforated, if necessary, by apertures having a major dimension not greater than 13 mm.

7.3.3.2 Any flue duct which passes through the airing space shall be double-walled or thermally insulated, unless the duct is surrounded by an air inlet duct.

*COMMENTARY ON **7.3.3.2***

For a double-wall chimney conforming to BS EN 1856-1, or for a flue duct concentric with an air inlet duct, the external skin and the air gap provide sufficient insulation and no extra precautions are necessary other than normal installation tolerances.

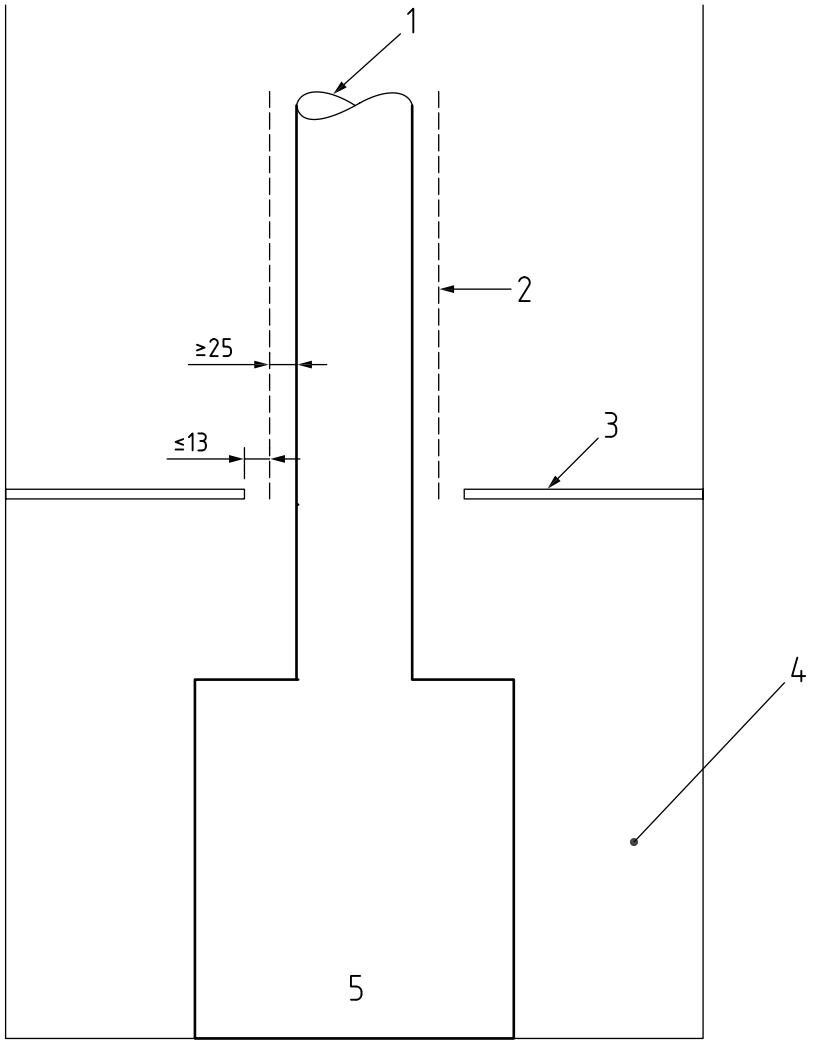
A single-wall chimney should be protected by an air gap of at least 25 mm for a distance of at least 1 m from the outlet connection of the micro-cogeneration appliance. This air gap can be provided by a non-combustible guard which forms an annular space around the chimney of not less than 25 mm.

Any clearance between the chimney guard and the compartment partition where the chimney passes through should not exceed 13 mm (see Figure 8).

Expanded metal or rigid wire meshes are suitable materials for the partition and guard.

Figure 8 **Micro-cogeneration appliance chimney clearances for airing cupboard installations**

Dimensions in mm



Key
1 Chimney
2 Guard
3 Compartment partition
4 Micro-cogeneration appliance compartment
5 Micro-cogeneration appliance

7.3.4 Under-stairs cupboard installations

If a micro-cogeneration appliance is installed in an under-stairs cupboard, the cupboard shall conform to one of the following.

a) Where the premises in which the cupboard is located has no more than two storeys, the cupboard shall conform to **7.3.2**.

b) Where the premises in which the cupboard is located has more than two storeys, all the internal surfaces of the cupboard, including the base, shall be non-combustible or lined with non-combustible material, having a fire resistance of not less than 0.5 h when determined in accordance with BS 476-22 and the air vents shall be direct to outside air.

*COMMENTARY ON **7.3.4***

Installation in an under-stairs cupboard should only be considered if there is no alternative location.

7.3.5 Bathroom and shower room installations

7.3.5.1 Micro-cogeneration appliances installed in a room or internal space containing a fixed bath or shower shall be room-sealed.

*COMMENTARY ON **7.3.5.1***

Installation in a bathroom or shower room should only be considered if there is no alternative location.

7.3.5.2 The electrical installation shall conform to BS 7671.

*COMMENTARY ON **7.3.5.2***

Attention is drawn particularly to BS 7671 with regard to zoning requirements in locations containing a bath or shower and to the requirement for RCD protection and protective equipotential bonding (if required).

7.3.5.3 The electrical supply to the micro-cogeneration appliance shall be provided via a double pole switched fused connection unit which is RCD-protected.

7.3.6 Bedroom and bed-sitting room installations

Room-sealed micro-cogeneration appliances shall only be installed in a bedroom or bed-sitting room where, after consultation with the owner of the property, the permission of the owner of the property has been obtained.

*COMMENTARY ON **7.3.6***

*Due to the need to ensure that the operational noise is not intrusive (see **7.3.12**), installation in a bedroom or bed-sitting room should only be considered if there is no alternative location.*

7.3.7 Toilet and cloakroom installations

The air vents for any micro-cogeneration appliance installed within a toilet or cloakroom shall be direct to outside air.

*COMMENTARY ON **7.3.7***

Installation within a toilet or cloakroom should only be considered if there is no alternative location.

7.3.8 Roof space installation

7.3.8.1 Roof spaces incorporating micro-cogeneration appliance installations shall conform to the following.

a) For an open system, vertical clearances shall be provided so that the static head requirement of **7.7.2.1** is met.

b) Flooring area sufficient to allow access for normal use and servicing shall be provided under and around the micro-cogeneration appliance and ancillary equipment. The appliance support shall be capable of supporting the load of the water-filled appliance, associated pipework and equipment.

*COMMENTARY ON **7.3.8.1**b)*

Where the floor is of combustible material and supports the micro-cogeneration appliance, a non-combustible insulating base at least 12 mm thick should be provided directly under the micro-cogeneration appliance.

c) A purpose-designed means of access to the installation shall be provided.

*COMMENTARY ON **7.3.8.1**c)*

A permanently-fixed retractable roof ladder is considered to satisfy the requirement for a purpose-designed means of access. A safety guard should be provided around the roof space access opening.

d) Fixed lighting for the installation and the means of access shall be provided.

e) A guard shall be provided to prevent contact between stored articles and the micro-cogeneration appliance, its associated pipework and chimney.

7.3.8.2 When a micro-cogeneration appliance is connected to an existing brick chimney at a level higher than the connection for a previous installation, the lower section of the chimney shall not be used. The unused lower portion of the chimney shall be sealed from the used portion by means of a plate inserted below the micro-cogeneration appliance connection to the chimney, but ensuring that other flues in the same chimney stack are not sealed off. Where the chimney is unlined, the plate shall be inserted to form a void extending approximately 250 mm below the micro-cogeneration appliance connection to the chimney.

*COMMENTARY ON **7.3.8.2***

Consideration should be given to providing access to the void immediately below the micro-cogeneration appliance connection to the chimney. Any openings into the lower portion of an internal flue, i.e. the sealed-off section, should be permanently closed off. For a chimney with at least one external face, the lower disused section should be ventilated to the external air at high and low level to prevent damp penetration.

7.3.9 External installation

7.3.9.1 A micro-cogeneration appliance installed in an external location shall either be:

a) specifically designated in the manufacturer's literature as being suitable for external installation without the need for additional protection; or

b) installed in an enclosure capable of providing permanent weather protection.

*COMMENTARY ON **7.3.9.1**b)*

The enclosure should be waterproof and the appliance protected by a frost thermostat.

7.3.9.2 If an enclosure is necessary, it shall conform to **7.3.2**. In addition, an accessible waterproof, double pole switched fused connection unit shall be fitted within the enclosure to completely isolate the micro-cogeneration appliance and all associated equipment, e.g. pumps, motorized valves, room thermostat. The enclosure shall be fitted with air vents direct to outside air, at both high and low level, in accordance with **7.1**.

*COMMENTARY ON **7.3.9.2***

The lowest part of the low-level vent should be not less than 300 mm above ground level. Any permanent openings to the enclosure, including those in the air vents, should have a minor dimension not greater than 10 mm in order to prevent the entry of birds or rodents. However, this dimension should not be less than 5 mm in order to minimize the risk of blockage. A means should be incorporated to prevent access by unauthorized persons to the micro-cogeneration appliance enclosure.

Attention is drawn to the building regulations (see Foreword), which can apply to such enclosures.

7.3.9.3 Micro-cogeneration appliances installed in an external enclosure shall be provided with a chimney as specified in **7.2**.

7.3.9.4 External gas pipework shall be protected against corrosion and damage in accordance with BS 6891 or IGEM/UP/2, Edition 2, as appropriate.

Water-carrying pipework shall be insulated against freezing as specified in BS 5422, and installed in accordance with BS 5970 (see **7.4.4.2**).

7.3.10 Other installations

A micro-cogeneration appliance installed in a location other than as described in **7.3.2** to **7.3.9** shall be installed in accordance with the manufacturer's instructions.

*COMMENTARY ON **7.3.10***

Information on chimneys for timber-framed and light steel-framed buildings is given in document IGE/UP/7, Edition 2.

Information on gas installations in flats and other multi-dwelling buildings is given in IGE/G/5.

Guidance on installations using 3rd family gases is given in BS 5482-1, BS 5482-2 and PD 5482-3.

7.3.11 Ambient conditions

The appliance shall be installed in a clean, dry, ventilated area that ensures that the manufacturer's stated acceptable upper and lower ambient temperature range is not exceeded.

*COMMENTARY ON **7.3.11***

The micro-cogeneration appliance may have an automatic feature that protects it from frost, but additional arrangements may need to be made to protect pipe-work from freezing.

7.3.12 Operating noise

A Stirling engine micro-cogeneration appliance is designed to operate for long periods of time (see Annex A), so the appliance shall be located such that the operating noise is not intrusive.

*COMMENTARY ON **7.3.12***

A Stirling engine micro-cogeneration appliance, as the name implies, includes an engine which can make an audible sound, and a micro-cogeneration appliance system is at its most efficient when designed to run for long periods of time. Hence the appliance can, if desired, start up in the early hours of the morning and have extended running times into the evening. Consequently, this aspect should be taken into consideration when choosing the appliance location.

Manufacturer's instructions usually contain advice on this aspect of choosing a suitable location, but if such advice is absent it is recommended that the manufacturer be contacted for guidance as to whether any or all of the following considerations are to be taken into account when deciding how to choose the location for their appliance.

a) Avoid installation in, near to, or directly below, a bedroom, study or other area dedicated to quiet activities.

b) Avoid installation in contact with stud partition walls that could act as a transmission path for the sound.

c) Avoid installation in an under-stairs cupboard where the structure of the stairs could act as a transmission path for the sound.

d) Avoid installation near to ventilation ducts or other cavities that could act as a transmission path for the sound.

A floor-mounted appliance, should not be installed on anything other than a solid concrete floor, unless a) positive steps have been taken to acoustically isolate the section of floor from the rest of the property and b) it has been established that the floor can take the weight of the filled appliance (Stirling engine micro-cogeneration appliances are often heavier than central heating boilers of equivalent size).

7.4 Protection

7.4.1 Open systems

For an open system, an open vent pipe shall be provided from the circulating system to discharge over the feed and expansion cistern above the level of the overflow connection. The internal diameter of the pipe shall be not less than 19 mm. The vent pipe shall rise continuously and be connected in such a position as to prevent discharge of water or ingress of air in all normal conditions of service. There shall be no valves or components other than full-bore pipe fittings between the micro-cogeneration appliance and the discharge point of the open vent pipe, unless specified in the manufacturer's instructions.

*COMMENTARY ON **7.4.1***

Except where the micro-cogeneration appliance manufacturer's instructions specifically state otherwise, the open vent pipe should be fitted to the flow connection or flow pipe from the micro-cogeneration appliance. The vent pipe may be used as part of the circulating system. Except where the micro-cogeneration appliance manufacturer's instructions specifically state otherwise, a close coupled cold feed and open vent configuration may be fitted provided that there is a cold water feed path available when all automatic valves are in the closed position. When this configuration is used the cold feed and open vent connections should be not more than 150 mm apart. Except where the micro-cogeneration appliance manufacturer's instructions specifically state otherwise, a combined feed and vent pipe may be fitted provided that the micro-cogeneration appliance incorporates an overheat cut-off device.

For further information on the installation of open vented cisterns, see the National Annex to BS EN 12828.

7.4.2 Sealed systems

For a sealed system, an expansion vessel conforming to BS EN 13831 shall be provided, which may be integral to the micro-cogeneration appliance (supplied by the micro-cogeneration appliance manufacturer) or external, or a combination of both. If external to the micro-cogeneration appliance, it shall be connected to the system by a pipe or fitting which does not incorporate valves of any sort. The vessel(s) shall have sufficient capacity to accept the expansion of the system water when heated from 10 °C to 110 °C without raising the pressure in the system to more than 0.35 bar below the lift pressure of the safety valve.

*COMMENTARY ON **7.4.2***

*Information concerning the calculation of vessel sizes is given in BS EN 12828:2003, National Annex NA, **4.7.1.2**. The expansion vessel itself might be located in a position remote from the heating circuit, but its connection with the circuit should be at a point close to the pump inlet. The charge pressure should be not less than the static head at the point of connection.*

7.4.3 Pressure-relief valve

7.4.3.1 A sealed system shall incorporate a pressure-relief valve. This valve shall either be supplied integral with the micro-cogeneration appliance or, where installed as a separate component, fitted as close as possible to the top of the micro-cogeneration appliance in the flow pipe with no intervening valve or restriction.

7.4.3.2 The location and method of fitting the pressure-relief valve shall be such that:

a) the discharge pipe for water or steam from the valve is capable of withstanding the maximum temperatures and pressures to which it is likely to be subjected under fault conditions, and falls throughout its length; and

b) the discharge is visible and will not discharge on to the occupants of the premises or on to any electrical components or wiring.

Alternatively, where an appliance incorporates an integral pressure-relief valve and the manufacturer specifies arrangements to discharge from a secondary valve above the height of the appliance, this guidance shall be followed, e.g. where sealed system micro-cogeneration appliances are to be sited in below-ground locations such as cellars.

7.4.3.3 Where a pressure-relief valve is installed as a separate component outside the micro-cogeneration appliance, it shall conform to BS EN 1491 for micro-cogeneration appliances of less than 44 kW rated output, or to BS EN ISO 4126-1 for appliances of 44 kW rated output and above. The valve shall be installed in accordance with the micro-cogeneration appliance manufacturer's instructions.

7.4.3.4 For sealed systems, pressure-relief valves shall have the following features:

a) a non-adjustable spring-loaded pre-set lift pressure not exceeding 3 bar;

b) a manual testing device; and

c) provision for connecting a full-bore discharge pipe.

*COMMENTARY ON **7.4.3.4***

*In addition to the requirements of **7.4.3.2** the pressure-relief valve should be located where its discharge is unlikely to cause damage to the premises.*

It is essential that the pressure-relief valve will not stick in the closed position and that it will reseal.

A pressure-relief valve is not necessary for an open system.

7.4.4 Freezing

7.4.4.1 A draining tap(s) shall be provided in an accessible position at the system low point(s) so that the whole system including the micro-cogeneration appliance can be drained.

7.4.4.2 Any micro-cogeneration appliance feed and expansion cistern, cold feed pipe, open vent pipe, overflow pipe or any circulating system pipework situated where it could be vulnerable to freezing (e.g. in a roof space) shall be protected by thermal insulation conforming to BS 5422:2009, Clause **11**, and be installed in accordance with BS 5970.

*COMMENTARY ON **7.4.4.2***

Insulation slows down but does not prevent loss of heat from water in a pipe. Insulation will not give complete protection if the temperature continues at or below freezing point. However, a suitable thickness will delay the onset of freezing. Further guidance is given in BS 6700. Consideration should be given to fitting a frost thermostat which should be set to operate at a temperature of approximately 4 °C. The thermostat should be sited and set in accordance with the micro-cogeneration appliance manufacturer's instructions. Pipe insulation should be continuous over pipe and fittings for frost protection and where condensation could occur. Where a feed and expansion cistern is fitted on joists in a roof space, insulation should not be fitted underneath it.

7.5 Gas supplies and pipework

7.5.1 First and second family gases

7.5.1.1 The gas supply pressure to the micro-cogeneration appliance shall be controlled in accordance with the micro-cogeneration appliance manufacturer's instructions.

7.5.1.2 Where a service pipe exists, the operative shall confirm with the gas supplier or public gas transporter that the pipe is of sufficient size for the maximum gas rate of the whole installation.

7.5.1.3 When a meter is fitted by a gas supplier or public gas transporter, the operative shall confirm that the meter is of sufficient capacity for the maximum gas rate of the whole installation.

*COMMENTARY ON **7.5.1.3***

A credit meter is preferred, and its installation should conform to BS 6400, Part 1 or 2, or IGE/GM/6, as appropriate. It is recommended that a "pay-as-you-go"-type tariff meter is not used as this could cause considerable inconvenience to the user and for this reason is not considered good practice. Such a meter should only be adopted at the insistence of the user or the gas supplier.

7.5.1.4 All gas installation pipes shall be sized and installed in accordance with BS 6891 or IGEM/UP/2, Edition 2, as appropriate.

*COMMENTARY ON **7.5.1.4***

When replacing an existing micro-cogeneration appliance and reusing the existing gas supply pipe, the operative should confirm that the pipe is of adequate size to supply the new appliance before fitting the appliance.

7.5.1.5 All micro-cogeneration appliances shall be provided with an adjacent isolating valve if this is not already supplied with the appliance.

7.5.2 Third-family gases

7.5.2.1 The gas storage vessels shall not be installed or stored in the micro-cogeneration appliance compartment or inside the premises.

7.5.2.2 All gas installations shall be sized and installed in accordance with BS 5482-1, BS 5482-2, PD 5482-3, IGEM/UP/2, Edition 2 or UKLPG Code of Practice 22, as appropriate.

*COMMENTARY ON **7.5.2.2***

Unless supplied from a central storage system, 3rd family gas installations do not normally incorporate a gas meter.

7.5.2.3 When a meter is already in place, the operative shall confirm that the meter and pipework is of sufficient capacity for the maximum gas rate of the whole installation.

*COMMENTARY ON **7.5.2.3***

A credit meter is preferred and its installation should conform to BS 6400-3. The use of a prepayment meter could cause considerable inconvenience to the user of the appliance and for this reason is not considered to be good practice.

A prepayment meter should only be adopted at the insistence of the user of the appliance or the gas supplier.

7.6 Electricity supplies and wiring

7.6.1 The following electrical issues shall be considered:

a) the maximum demand (and the generator output);

b) the type of earthing arrangement;

c) the nature of the supply;

d) external influences;

e) compatibility, maintainability and accessibility;

f) protection against electric shock;

g) protection against thermal effects;

h) protection against overcurrent;

i) isolation and switching;

j) equipment selection and installation issues.

*COMMENTARY ON **7.6.1***

It is unlikely for the size of micro-cogeneration appliances covered by this standard that the prospective fault current will change sufficiently to exceed the fault rating of existing protective devices, but this should be confirmed.

7.6.2 Connection of a micro-cogeneration appliance to the distributing main shall be by either:

a) connection into a dedicated electrical circuit (with no other appliances connected to the circuit); or

b) connection into an existing electrical circuit with additional loads connected.

NOTE Connection into a dedicated circuit is preferred.

For both options:

1) the winding of the a.c. micro-cogeneration appliance shall not be earthed;

2) the micro-cogeneration appliance shall not be connected to an installation by means of a plug and socket;

3) protection shall be provided to disconnect the micro-cogeneration appliance from the mains automatically in the event of loss of normal mains supply;

4) where a micro-cogeneration appliance is installed within a special location covered by a specific section of BS 7671, Part 7, the requirements applicable to that special location shall be applied.

*COMMENTARY ON **7.6.2**, item3)*

This protection will be incorporated in, or supplied with, the appliance.

*COMMENTARY ON **7.6.2**, item 4)*

Examples of the applicable requirements are limitations on the positioning of the micro-cogeneration appliance, additional protection with a 30 MA double pole RCD, supplementary bonding, or the selection of a micro-cogeneration appliance with a specified IP (ingress protection) rating.

7.6.3 In addition to **7.6.2**, 1) to 4), for the connection of a micro-cogeneration appliance to a dedicated circuit:

a) basic design parameters for the circuit shall be:

- $I_b \geq I_g$, where I_b is the design current and I_g is the rated output current of the micro-cogeneration appliance;
- $I_n \geq I_b$, where I_n is the normal current of the overload protection device;
- disconnection of the circuit in the event of an earth fault on the circuit within 5 s for TN systems and 1 s for TT systems;

b) where a micro-cogeneration appliance is connected on the same side of an RCD as final circuits protected by that RCD, the RCD shall disconnect the line and neutral conductors;

c) the micro-cogeneration appliance shall be provided with a means of isolation and of switching off for mechanical maintenance.

*COMMENTARY ON **7.6.3**a)*

A "system" is defined as an electrical system consisting of a single source or multiple sources running in parallel of electrical energy and an installation. For the purposes of Regulations, types of system are identified as follows, depending on the relationship of the source(s), and of exposed-conductive parts of the installation, to Earth.

a) TN system: has one or more points of the source of energy directly certified, the exposed-conductive parts of the installation being connected to that point by protective conductors.

b) TN-C system: in which neutral and protective functions are combined in a single conductor throughout the system.

c) TN-S system: has separate neutral and protective conductors throughout the system.

d) TN-C-S system: in which neutral and protective functions are combined in a single conductor in part of the system.

e) TT system: has one point of the source of energy directly earthed, the exposed-conductive parts of the installation being connected to earth electrodes electronically independent of the earth electrodes of the source.

7.6.4 In addition to **7.6.2**, 1) to 4), for the connection of a micro-cogeneration appliance to an existing final circuit:

a) basic design parameters for the circuit shall be:

1) $I_z > I_n + I_g$, where I_z is the current carrying capacity of the conductors of the final circuit, I_n is the nominal current of the overload protective device and I_g is the rated output current of the micro-cogeneration appliance;

2) disconnection of the final circuit in the event of an earth fault on the circuit and de-energization of the micro-cogeneration appliance shall both occur within an overall maximum time of 0.4 s for TN systems and 0.2 s for TT systems; however, if the protective device for automatic disconnection in case of an earth fault disconnects line and neutral conductors, it is not necessary to take account of the time taken for the micro-cogeneration appliance to de-energize;

b) an RCD providing additional protection for the final circuit shall disconnect all line and neutral conductors;

c) the micro-cogeneration appliance shall be provided with a means of isolation from the remainder of the final circuit and of switching off for mechanical maintenance.

*COMMENTARY ON **7.6.4**a)*

This could require the protective device to be replaced with one having a lower nominal current rating.

*COMMENTARY ON **7.6.4**c)*

If an RCBO with unswitched neutral is used, an earth fault will cause operation of the RCBO, but the micro-cogeneration appliance can still supply current through the earth fault for a period until its own internal protection against loss of mains causes the micro-cogeneration appliance to shut down.

A single pole RCBO with an RCD element provided for additional protection against electric shock is not permitted; the RCBO needs to switch both line and neutral conductors.

7.6.5 Electricity supplies to the micro-cogeneration appliance and any ancillary controls shall be installed in accordance with the manufacturer's instructions. Only electrical components designed for the electrical supply voltage and of a rating sufficient to carry the electrical current required by the operation of the equipment shall be used. The micro-cogeneration appliance and its controls shall be suitably IP-rated for use in the intended location.

7.6.6 The micro-cogeneration appliance shall have a means of isolation fitted as close as practicable to its output terminals. This shall be capable of disconnecting all live conductors, including the neutral, from the mains supply.

The means of isolation shall be manual, capable of being secured in the "off" isolating position and located in an accessible position in the consumer's installation.

*COMMENTARY ON **7.6.6***

The Institution of Electrical Engineer's Electrician's Guide to the Building Regulations *[21] advises that a minimum of 300 mm should be allowed from the edge of kitchen sinks and draining boards to the appliance's point of connection to the mains electricity to reduce the risk of being splashed.*

7.6.7 Labelling shall be provided in accordance with Engineering Recommendation G83/1/1.

*COMMENTARY ON **7.6.7***

The Electrical Safety Council's Best Practice Guide No. 3, Connecting a microgeneration system to a domestic or similar electrical installation (in parallel with the mains supply) *[22] provides illustrative examples of the types of labels required.*

7.6.8 All fuses used shall be in accordance with the micro-cogeneration appliance and component manufacturers' instructions.

7.7 Water supplies and pipework

NOTE Attention is drawn to the Water Fittings Regulations [10] or relevant by-laws, which apply to the design and installation of all hot water systems.

7.7.1 General

The proximity to the micro-cogeneration appliance of any plastic pipe or fitting shall be limited in accordance with the pipe/fitting manufacturer's and the micro-cogeneration appliance manufacturer's instructions. The pressure rating of plastic pipes and fittings shall be appropriate for the maximum operating pressure of the system. Plastic pipe and fittings shall be selected from those which have been verified and listed in the Water Fittings and Materials Directory (see Commentary on **6.4**) and they shall be used in accordance with the recommendations of the pipe/micro-cogeneration appliance manufacturer.

*COMMENTARY ON **7.7.1***

In considering the suitability of any plastic pipe and/or fitting, the following should be taken into account:

a) the manufacturer's instructions on close connection to the micro-cogeneration appliance;

b) deterioration due to sunlight;

c) porosity; and

d) conformity with the recommendations of the pipe/micro-cogeneration appliance manufacturer.

7.7.2 Open systems

7.7.2.1 Feed and expansion cistern

In open systems, a feed and expansion cistern shall be fitted in accordance with the National Annex to BS EN 14336. The cistern shall be fitted so that its base is at least 1 m above the highest point of the circulating system or at such lesser height as specified in the micro-cogeneration appliance and pump manufacturers' installation instructions.

The internal diameter of the warning/overflow pipe shall be not less than 19 mm.

*COMMENTARY ON **7.7.2.1***

When the feed and expansion cistern is manufactured from plastics or similar materials, it should be supported over the entire area of its base. It is recommended that any support extends a minimum 150 mm in all directions beyond the edge of the maximum dimensions of the cistern.

7.7.2.2 Hot-water storage vessel

Any independent hot-water storage vessel shall be installed in accordance with the National Annex to BS EN 14336.

*COMMENTARY ON **7.7.2.2***

Pipework connections should be in accordance with the storage vessel and micro-cogeneration appliance manufacturers' instructions. This is particularly important when it is proposed to use a hot water storage combination unit conforming to BS 3198.

7.7.2.3 Primary cold feed

7.7.2.3.1 The primary cold feed pipe from the feed and expansion cistern to the micro-cogeneration appliance or heating system shall be made of copper or stainless steel, or of a plastics material (see **7.7.1**).

7.7.2.3.2 The internal diameter of the primary cold feed pipe shall be not less than 13 mm, except in the case of a combined cold feed and open vent pipe where the internal diameter shall be not less than 19 mm.

7.7.2.3.3 The primary cold feed pipe shall not supply water for any other purpose.

7.7.2.3.4 The primary cold feed pipe shall not be fitted with a valve or other component unless required by the local water supplier. Where required, the valve or any other component shall be full bore.

7.7.2.4 Single-feed systems

A cold feed to a single-feed system (heating and storage hot water separated by an air bubble) shall conform to **7.7.2.3.1** to **7.7.2.3.4**.

7.7.3 Sealed systems

7.7.3.1 Filling and make-up equipment

In sealed systems, facilities shall be provided for filling the system and for water make-up as specified in the National Annex to BS EN 14336.

*COMMENTARY ON **7.7.3.1***

Attention is drawn to the Water Supply (Water Fittings) Regulations, as amended [10], and relevant by-laws.

7.7.3.2 Fittings

All water-carrying components used, including the pump and the primary circuit of the indirect hot-water storage cylinder, shall be designed for operation at 110 °C and at the maximum pressure permitted by the safety valve. Single-feed cylinders shall not be used in sealed primary systems.

*COMMENTARY ON **7.7.3.2***

Single-feed cylinders are not designed for use with sealed primary systems.

7.7.3.3 Venting

Provision shall be made to vent air from the system.

*COMMENTARY ON **7.7.3.3***

The system may be vented either by automatic air vents or manually. Hygroscopic types of automatic air vent should not be used for sealed systems, as they allow continuous evaporation of small quantities of water.

7.7.3.4 Methods of filling sealed systems

Sealed systems shall be filled in accordance with BS 6700, where applicable.

*COMMENTARY ON **7.7.3.4***

Attention is drawn to the Water Supply (Water Fittings) Regulations (as amended) [10] or relevant by-laws.

7.7.4 Waterways

7.7.4.1 The whole of the primary heating system shall be thoroughly cleansed and flushed out before a new micro-cogeneration appliance is installed.

Unless a single-feed cylinder is connected to the system (see **7.7.4.2**), a chemical cleanser appropriate for the materials of the system shall be used in accordance with any special instructions from the manufacturer of the micro-cogeneration appliance and manufacturer of the cleanser. The cleanser used shall be compatible with any inhibitor which is to be added to the system.

*COMMENTARY ON **7.7.4.1***

*Reasonable provision on how to cleanse and flush out the system is given in BS 7593:2006, Clause **5**.*

The chemical cleanser should be added to the system on the initial fill and any air locks cleared. The whole system should be heated to maximum working temperature and examined for leaks. The system should then be switched off and rapidly drained while still hot, to remove any foreign matter and excess flux. The system should again be filled, cleared of air locks and re-examined for water leaks. Further guidance on system cleansing and flushing is given in BS 7593.

7.7.4.2 Chemical cleansers shall not be used if single-feed cylinders or similar devices are fitted to the system.

*COMMENTARY ON **7.7.4.2***

Devices that depend upon an air bubble with no physical barrier between the two circuits could allow water from the central heating circuit to contaminate the domestic hot water supply.

7.8 Selection of heating system controls

The heating system controls chosen shall be in accordance with the appliance manufacturer's instructions.

*COMMENTARY ON **7.8***

The control systems built into micro-cogeneration appliances are very sophisticated, and matching the heating system controls to the appliance is important. There are so many variations of appliance control systems and heating control systems on the market that it is not possible to provide generic recommendations.

Choosing the heating system controls best suited to a particular appliance, heating system and property will depend on many factors and the manufacturer's instructions should be consulted for their recommendations before making this choice.

8 Post-installation

8.1 Inspection

Before it is commissioned, the micro-cogeneration appliance installation shall be inspected to ensure that the work has been carried out in accordance with Clause **6** of this standard, the micro-cogeneration manufacturer's instructions, the relevant sections of the current Gas Safety (Installation and Use) Regulations [1], Engineering Recommendation G83/1/1 and BS 7671.

*COMMENTARY ON **8.1***

Attention is drawn to:

*a) the requirement for labelling of the installation in **7.6.7**; and*

b) the Gas Safety (Installation and Use) Regulations [1], particularly to the requirements that:

1) the provision of ventilation air and combustion air is adequate;

2) the chimney is correctly constructed;

3) the general condition of the micro-cogeneration appliance and the installation are adequate; and

4) the gas fittings and other works for the supply of gas are adequate.

8.2 Commissioning

NOTE 1 Schedule 1 of the Building Regulations 2000 (England and Wales), as amended [6] require a notice signed by a suitably qualified person that includes a declaration that the manufacturer's commissioning procedures have been completed satisfactorily.

For example, an Installation and Commissioning Checklist is provided by most micro-cogeneration manufacturers at the rear of the appliance instruction manual.

NOTE 2 Engineering Recommendation G83/1/1 describes the connection, commissioning and notification process for micro-cogeneration appliances typically required by a DNO.

8.2.1 Final filling of the system

8.2.1.1 During final filling of the system a chemical water treatment formulation shall be added to the primary circuit to control corrosion and the formulation of scale and sludge.

The chemical treatment used shall be appropriate to the micro-cogeneration appliance and to the metals in the system, e.g. steel, copper or aluminium, and shall be introduced into the system according to the manufacturer's instructions. A label indicating that the system has been so treated shall be attached to the system, indicating the nature of the inhibitor present and the date of its addition.

*COMMENTARY ON **8.2.1.1***

Reasonable provision for final filling of the system would be to follow the guidance given in BS 7593.

The micro-cogeneration manufacturer's instructions should be consulted for guidance on appropriate products. The use of an unsuitable inhibitor can have detrimental effects. It should be noted that many types of inhibitor can be used only with certain materials and the micro-cogeneration appliance/inhibitor manufacturer's instructions should be consulted concerning compatibility of any inhibitor with all the materials in the system. For further advice, BS 7593 should be consulted.

The local water supplier can be consulted for advice concerning the quality of the local water supply.

The inhibitor concentration should be rechecked annually, further inhibitor being added when necessary, to maintain the optimum dosage.

Unless the manufacturer(s) states to the contrary, products from different manufacturers or different products from the same manufacturer should not be mixed.

8.2.1.2 Inhibitors and biocides shall not be used where single-feed cylinders or similar devices, e.g. single feed automatic recovery tanks, are fitted in a system.

*COMMENTARY ON **8.2.1.2***

Devices that depend upon an air bubble with no physical barrier between the two circuits could allow water from the central heating circuit to contaminate the domestic hot water supply.

8.2.1.3 Naturally soft waters of low alkalinity or those supplied via a base-exchange resin softener shall only be used in any central heating system if a corrosion inhibitor specifically formulated for the purpose is added. Inhibitor manufacturers shall be consulted for advice, paying particular attention to dosage levels, and the owner of the appliance should be made aware of the need to have the system properly maintained.

*COMMENTARY ON **8.2.1.3***

Naturally soft waters of low alkalinity or those supplied via a base-exchange resin softener have an increased potential for corrosion, and if they are to be used in any central heating system a corrosion inhibitor specifically formulated for the purpose should be added and properly maintained.

8.2.2 Micro-cogeneration appliance

8.2.2.1 The micro-cogeneration appliance shall be put into operation and commissioned in accordance with the manufacturer's instructions.

*COMMENTARY ON **8.2.2.1***

The micro-cogeneration appliance manufacturer's instructions should be consulted for guidance on the appropriate commissioning procedure for the specific micro-cogeneration appliance and heating system.

8.2.2.2 The operative shall ensure that the heat input is measured and, where necessary, correctly adjusted in accordance with the manufacturer's instructions.

*COMMENTARY ON **8.2.2.2***

Where appropriate, the pressure at the burner pressure test point should be checked to ensure that it is in accordance with the recommended value. The gas rate can be measured by the gas meter test dial or index, having first ensured that no other appliance supplied through the meter is in operation and that the micro-cogeneration appliance is operating at its nominal rate throughout the measurement, i.e. without cycling or modulating.

These checking and adjustment procedures should be carried out with the burner in the hot condition. It is recommended that a heat-up time of at least 10 min is allowed, except where the manufacturer's instructions advise otherwise. The heat input may be quoted on the basis of either net or gross calorific value. The operative should establish from the manufacturer's instructions which of these is being quoted. If there is any doubt, the micro-cogeneration appliance manufacturer should be contacted. When a heat input is to be calculated from a measured gas rate, the appropriate gross or net calorific value (CV) should be used.

Where:

a) there is no meter to measure directly the heat input into the gas appliance; and

b) it is not possible to measure the operating pressure of the gas appliance because it incorporates a pre-mix burner and a zero set pressure regulator,

it is permissible to use the measured combustion performance to demonstrate that the appliance is operating safely [see the HSE Certificate of Exemption No.1 2008, for which further guidance is given in Technical Bulletin 021 [23] (available on the Gas Safe Register website www.gassaferegister.co.uk)].

Where the measured combustion performance is used to demonstrate that the appliance is operating safely, the operative will need to:

1) have access to the micro-cogeneration appliance manufacturer's instructions and a calibrated electronic portable combustion gas analyser conforming to BS 7927 or BS EN 50379-3; and

2) be competent in its use and the interpretation of any reading obtained.

This competence can be demonstrated by satisfactory completion of the CPA1 ACS assessment, which covers the use of electronic portable combustion gas analysers.

8.2.2.3 The air supply and the operation of the chimney system shall be checked to ensure that the products of combustion are being safely removed.

*COMMENTARY ON **8.2.2.3***

The safe removal of combustion products should be checked by the method described in the manufacturer's installation instructions. If these are not specific, the method given in BS 5440-1 should be used.

8.2.2.4 After the micro-cogeneration appliance heat input has been confirmed (see **8.2.2.2**) the primary water flow rate shall be adjusted to conform to the manufacturer's instructions.

*COMMENTARY ON **8.2.2.4***

The normal water flow rate is that which produces an 11 °C temperature differential across the system or a temperature differential across the micro-cogeneration appliance. However, some micro-cogeneration appliances require a different temperature differential, which will be defined in the manufacturer's instructions. The temperature differential should be measured at the flow and return pipes as close to the micro-cogeneration appliance as possible, when the system is in full operation and the flow temperature is approaching the micro-cogeneration appliance thermostat cut-off point. Adjustment should be made using the variable head pump adjustment and/or by alteration of a control valve provided for the purpose in the main flow pipe of the system and/or by adjusting the bypass (if fitted).

8.2.2.5 The micro-cogeneration appliance controls, safety devices and system controls shall be checked to ensure that they function in accordance with the manufacturer's instructions.

*COMMENTARY ON **8.2.2.5***

Where the manufacturer's instructions require the combustion performance to be checked, the operative has to have access to a calibrated electronic portable combustion gas analyser conforming to BS 7927 or BS EN 50379-3, and be competent in its use and the interpretation of any reading obtained. This competence can be demonstrated by satisfactory completion of the CPA1 ACS assessment, which covers the use of electronic portable combustion gas analysers.

8.3 Advice to user of the appliance

NOTE This is advice to be given to the user by the operative at the time of handover.

8.3.1 User instructions

8.3.1.1 The operative shall ensure that the user has been provided with the manufacturer's instructions for operating the micro-cogeneration appliance.

NOTE The GSIUR [1] require that all the manufacturer's instructions are left with the customer.

8.3.1.2 The correct operating procedure for the micro-cogeneration appliance, any safety shut-off controls and ancillary controls shall be demonstrated to the user.

*COMMENTARY ON **8.3.1.2***

It is recommended that a system layout diagram and instructions for operating ancillary controls be provided by the operative.

The user should be informed that an independently-mounted carbon monoxide detector having an audible alarm (conforming to BS EN 50291) may be fitted in a room containing a gas appliance to give reassurance to customers, but that the detector should not be regarded as a substitute for correct installation and regular servicing by a competent person.

Where an independently mounted carbon monoxide audible alarm to BS 7860 is already fitted in a room containing a gas appliance the operative should advise the user that manufacture of such alarms to BS 7860 ceased in March 2006, by which time all manufacture of such alarms was to the updated requirements of BS EN 50291. With the expected working life of BS 7860 alarms of around five years, the user should be recommended to replace the alarm with one manufactured to BS EN 50291.

8.3.1.3 The owner of the micro-cogeneration appliance shall be advised that it is their (the owner's) responsibility to ensure that the safety labelling specified in **7.6.7** is maintained and kept up-to-date.

*COMMENTARY ON **8.3.1.3***

It should be explained to the owner of the appliance that the labelling is provided to ensure not only their (the owner's) safety, but also the safety of any subsequent operative who might be required to carry out work on the appliance or the associated electrical system in the future. Hence, the need to ensure the labelling is not damaged, obscured or removed (i.e. maintained) and kept up-to-date (for example, if the electrical connection was to be changed in the future).

The owner should be advised that periodic testing and inspection of the electrical installation by a competent operative at intervals not greater than those recommended in the IEE Guidance Note 3, Inspection and Testing [24] will ensure that the owner is seen to be discharging their duty to keep the safety labelling up-to-date.

8.3.2 Precautions

The user shall be advised of any precautions necessary to prevent damage to the micro-cogeneration appliance system or the building if the system remains inoperative during freezing conditions.

8.3.3 Maintenance

If the premises in which the micro-cogeneration appliance is installed are owned by the occupier, the occupier shall be advised in writing that, for continued efficient and safe operation of the appliance, it is important that adequate and regular maintenance of the micro-cogeneration appliance and heating system is carried out by a competent person (i.e. a Gas Safe Register-registered operative) in accordance with the appliance manufacturer's recommendations.

If the premises are tenanted and the landlord owns the gas appliance, the landlord shall be advised in writing of the duty imposed by the Gas Safety (Installation and Use) Regulations [1] to ensure that the appliance installation is maintained in a safe condition and checked for safety every 12 months.

*COMMENTARY ON **8.3.3***

The Gas Safety (Installation and Use) Regulations [1] impose a general obligation on landlords providing gas appliances in tenanted premises to have these maintained in a safe condition and checked for safety every 12 months.

Where an independently-mounted carbon monoxide audible alarm conforming to BS EN 50291 is fitted in or recommended for a room containing a gas appliance the operative should advise the user that such an alarm is not to be regarded as a substitute for proper installation and regular servicing by a competent person.

Where an independently-mounted carbon monoxide audible alarm conforming to BS 7860 is already fitted in a room containing a gas appliance the operative should advise the user that manufacture of such alarms to BS 7860 ceased in March 2006, by which time all manufacture of such alarms was to the updated requirements of BS EN 50291. With the expected working life of BS 7860 alarms of around five years, the user should be recommended to replace the alarm with one manufactured to BS EN 50291.

*The user should be advised that the maintenance ought to include an annual check of the inhibitor concentration (see **8.2.1.1**).*

8.4 Service and maintenance

The service and maintenance of the micro-cogeneration appliance and heating system shall be carried out by a competent person (see Clause **4**) in accordance with the appliance manufacturer's recommendations.

Where the manufacturer's instructions require the combustion performance to be checked, the operative shall have access to a calibrated electronic portable combustion gas analyser conforming to BS 7927 or BS EN 50379-3, and shall be competent in its use and the interpretation of any reading obtained.

NOTE This competence can be demonstrated by satisfactory completion of the CPA1 ACS assessment, which covers the use of these electronic portable combustion gas analysers

*COMMENTARY ON **8.4***

Where:

a) there is no meter to measure directly the heat input into the gas appliance; and

b) it is not possible to measure the operating pressure of the gas appliance because it incorporates a pre-mix burner and a zero set pressure regulator,

it is permissible to use the measured combustion performance to demonstrate that the appliance is operating safely; see the HSE Certificate of Exemption No.1 2008, for which further guidance is given in Technical Bulletin 021 [23] (available on GSR website: https://engineers.gassaferegister.co.uk/).

In the case of a room-sealed fanned draught flue system concealed within a void, advice on inspection of the flue system is given in Technical Bulletin 008 [15].

Where any defects that cannot be rectified are identified as part of any maintenance or safety check activity, reference should be made to the requirements of the Gas Industry Unsafe Situations Procedure *[25].*

Annex A (informative) How a typical Stirling engine micro-cogeneration appliance works

A.1 Introduction

The role of a micro-cogeneration appliance in a heating system is similar to that of a central heating boiler and it is easy to assume that it is a boiler that happens to generate electricity.

This is a useful way of describing it when explaining the concept to a user, but for those involved in the design, installation, inspection, commissioning, servicing or maintenance of a micro-cogeneration appliance, it is important to think of the micro-cogeneration appliance in the opposite way, i.e. as an electricity generator that happens to provide heat. There are similarities in function with a central heating boiler; there are also some very important differences. Thinking about the device as a generator will help to keep them in mind.

A micro-cogeneration appliance is designed to be the central component in what is known as a micro-cogeneration system. That is, a CHP (combined heat and power) system of a size where the equipment can be installed in a domestic environment.

Traditional commercial CHP systems are large-scale installations that make use of the heat produced from electricity generation to provide heating and hot water. This improves the efficiency of the generation process, but has the disadvantage that the heat produced is limited to use in properties that are located very close to the generating source.

A micro-cogeneration appliance utilizes the same principles, but uses a small-scale generating unit that is installed as an alternative to a standard domestic boiler. When operating, the micro-cogeneration appliance generates both electricity and heat. The electricity produced is available for use in the house and the heat is used for both central heating and domestic hot water.

A.2 Constituent parts of a typical Stirling engine micro-cogeneration appliance

Typically, a micro-cogeneration appliance (see Figure A.1) consists of:

a) an electrical generator that provides 230 V a.c. power (nominal grid voltage);

b) a Stirling engine that provides the motive power for the generator;

c) a gas burner assembly that provides the heat necessary for the operation of the Stirling engine;

d) a heat exchanger that recovers heat from the hot gases produced by the burner; and

e) an auxiliary burner that produces additional heat at times of high demand.

In addition to these items, similar to those found in a typical condensing boiler are:

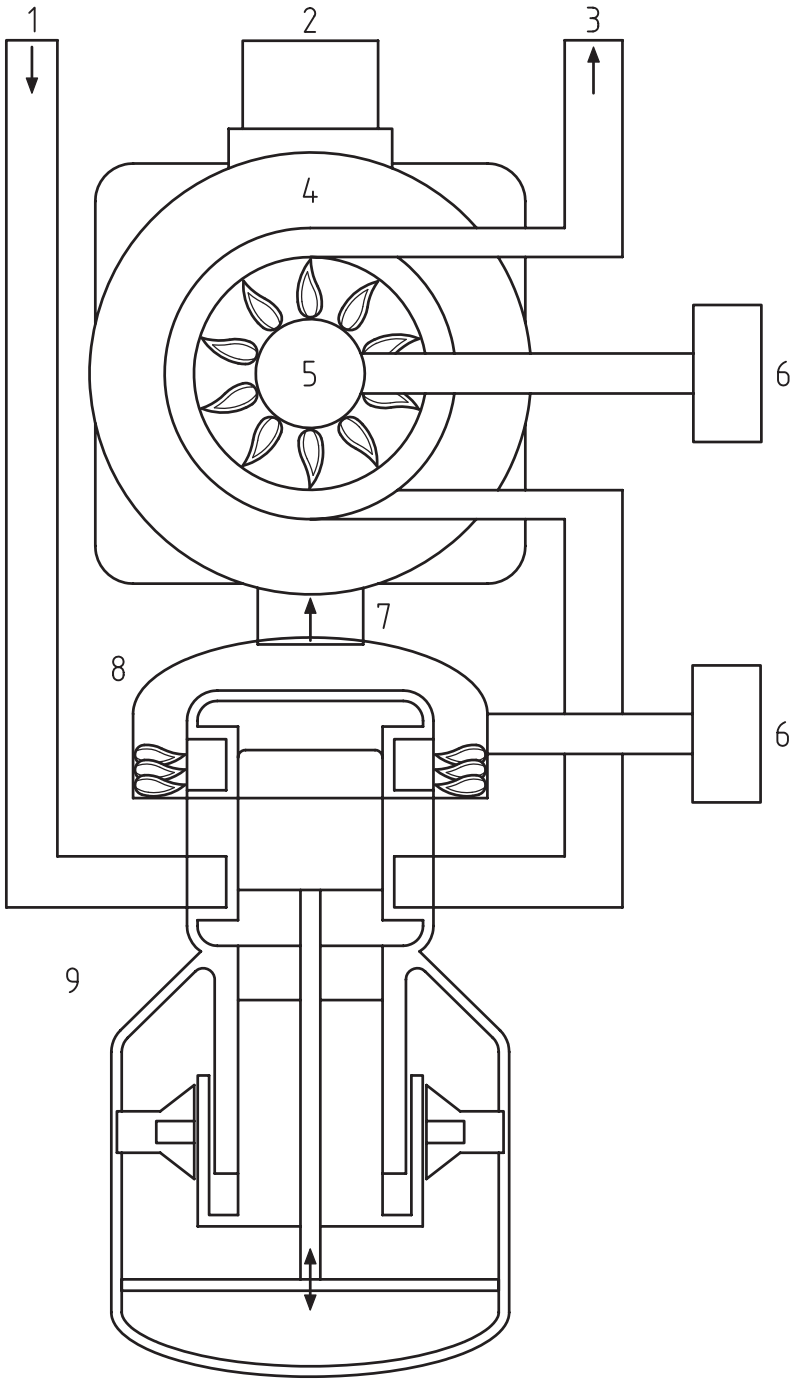
1) connecting pipework;

2) microprocessor-based electronic control circuits;

3) an LCD display screen to provide the user interface for the appliance; and

4) a fan connected to a chimney system, which provides combustion air for the burner(s) and passes the waste gases from the combustion process to the atmosphere.

Figure A.1 **Diagram of a typical micro-cogeneration appliance**

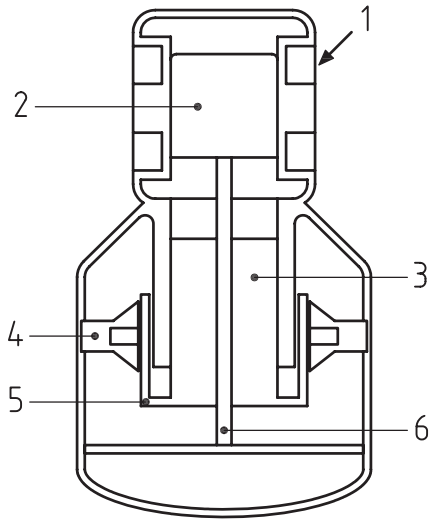


a)

Key

1	Return	6	Gas valve
2	Flue outlet	7	Hot gases
3	Flow	8	Engine burner
4	Exhaust gas heat exchanger	9	Generator
5	Auxiliary burner		

Figure A.1 **Diagram of a typical micro-cogeneration appliance**



b)

Key

1 Heat in from gas burner
2 Displacer piston
3 Piston
4 Alternator
5 Power piston
6 The displacer moves working gas from the hot to the cold end of the chamber, whether expanding or contracting

A.3 How does the Stirling engine work?

The Stirling engine has a number of pistons that are driven by the expansion and contraction of a working gas (e.g. nitrogen or helium), which is sealed in the engine's cylinders under pressure.

The working gas expands when it is heated by fuel burned in a combustion chamber located outside the cylinders (rather than within the cylinders as in the internal combustion engine used in motor cars).

A Stirling engine requires effective cooling and it is this feature that is used to make the engine a source of heat as well as electrical power. The water in the home's central heating system is used as coolant for the engine and is heated in the process.

A brief description of a typical operation sequence for a Stirling engine micro-cogeneration appliance (as illustrated in Figure A.1) is as follows:

a) an engine burner burns gas in the combustion chamber mounted on top (the "hot end") of the engine;

b) the central heating return water passes through a water jacket around the engine, where it is heated and provides cooling for the "cold end" of the engine;

c) the heat produced by the engine burner expands the working gas in the engine and provides the motive power for the Stirling engine to move the working gas from the hot to the cold end of the lower chamber (or vice versa), depending on whether the working gas is expanding or contracting;

d) this drives the generator, which produces AC power for the home;

e) the central heating water passes through the engine burner "exhaust gas" heat exchanger where it is heated by the hot gases from the engine burner combustion process (at times of high heat demand an auxiliary burner provides additional heat); and

f) the resulting hot water is then piped out to the heating system.

A.4 The Stirling engine micro-cogeneration system in operation

Although a micro-cogeneration may be marketed as a boiler replacement, because it produces both electricity and heat it will often operate in a way that is quite different to conventional gas boiler systems. It is important to understand both the reason for the differences in operation and the impact it can have on the user's experience.

Although there are many advanced controls available, the design of conventional gas central heating systems is typically based on controlling the boiler to operate up to its maximum temperature and switching the boiler on and off to match the heating and hot water load of the property. This means that under conditions of reduced demand the boiler operates for relatively short periods.

In order to gain the greatest benefits from a Stirling engine micro-cogeneration system, the engine generator should be given priority to provide the heat needed by the property. The auxiliary burner will then operate to meet the remaining heat load that cannot be satisfied by the Stirling engine on its own. This means that a Stirling engine micro-cogeneration appliance may run for longer periods and cycle on and off less frequently than a conventional boiler installed in the same property.

This is an intentional part of the design; the purpose is to maximize the amount of time that the generator operates, and consequently maximize the quantity of electricity that is generated at peak times.

The designer of the heating system needs to understand this operational difference; for existing heating systems where the micro-cogeneration appliance is replacing an existing gas boiler it might be necessary to modify the existing system design and time controls to accommodate this difference.

Hence it is important to follow the appliance manufacturer's instructions when designing the system. This operation characteristic can be obtained in several ways and will depend on the design of the micro-cogeneration appliance.

This operational difference could also influence how the user perceives the performance of the system, and it is important that the operation of the installed system is explained to the user so that they know what to expect from the system.

NOTE Without adequate explanation, if the user's heating system was previously provided by a high output gas boiler, they could incorrectly perceive the different response pattern of the heating system as:

a) an indication of a fault; or

b) evidence that its output is inadequate for the task; or

c) wasteful of energy and be tempted to alter the control settings unnecessarily.

Annex B (informative) Matching the heat output of the micro-cogeneration appliance to the heat load of the property

B.1 Introduction

To assess whether the output of the micro-cogeneration appliance will be sufficient it is necessary to establish the maximum heat loss of the property. This indicates how much heat will be required to heat the property, and whether the output of the micro-cogeneration appliance is adequate to provide comfortable temperatures.

B.2 Where to obtain the heat loss information

The heat load of a property is made up of three basic components:

a) the building fabric loss (heat loss through the walls, windows, roof, etc.);

b) the building ventilation loss (heat loss through fresh cold air being drawn into the house for ventilation); and

c) the domestic hot water requirement.

The first two of these are used for a number of purposes during the design of a new property and it might be possible to obtain them from the data that the architect has used to design the building.

If a reliable figure is not available, or the property is not a new property, the design heat loss of the dwelling can be established using one of the following procedures:

1) *The Whole House Boiler Sizing Method for houses and flats*. This is an interactive calculator available under "Recommended boiler size" at www.sedbuk.com

It is also available in printable form at:

http://www.energysavingtrust.org.uk/Publications2/Housing-professionals/Heating-systems/Domestic-heating-sizing-method-2010-edition

The design heat loss in Watts is to be taken as the sum of boxes E and F only (the additional figure for water heating in section 7 is ignored).

2) *The Domestic Heating Design Guide* published by CIBSE [26]. The design heat loss is calculated on Worksheet 1 in Appendix F as the sum of the heat losses from each room, with final adjustments for exposed location, high ceilings, etc.

3) *The HHIC Heat Loss Calculator & Radiator Selector* published by the Heating and Hotwater Industry Council. The design heat loss is calculated as the sum of the heat losses from each room. See:

http://www.centralheating.co.uk/index/fuseaction/site.articleDetail/con_id/5528

B.3 Matching the micro-cogeneration appliance's output to the heat load of the property

For optimum performance a ratio (referred to as the plant size ratio) of the nominal rated heat output of the micro-cogeneration appliance in Watts divided by the estimated heat loss of the property in Watts of between 1.2 and 1.7 (with the ideal being 1.5), should be the target.

NOTE It is recommended that:

a) if the micro-cogeneration appliance is to be installed in a property with an estimated heat loss greater than the nominal rated heat output of the micro-cogeneration appliance, a supplementary heat source should also be installed;

*b) if the estimated plant size ratio is greater than 1.7 the installation should make use of a thermal storage system to avoid excessive cycling (see **6.5**).*

Further guidance on assessing the environmental performance of a heat led micro-cogeneration appliance can be found in Annex B, *Environmental Performance*, of the Department of Energy and Climate Change (DECC) publication Microgeneration Installation Standard: MIS 3007 [27].

Bibliography

Standards publications

For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS 3198, *Specification for copper hot water storage combination units for domestic purposes*

BS 3632, *Residential park homes – Specification*

BS 5258-1, *Safety of domestic gas appliances – Part 1: Specification for central heating boilers and circulators*

BS 5258-8, *Specification for safety of domestic gas appliances – Part 8: Combined appliances:gas fire/back boiler*

BS 5546, *Specification for installation of hot water supplies for domestic purposes, using gas-fired appliances of rated input not exceeding 70 kW*

BS 5449, *Specification for forced circulation hot water central heating systems for domestic premises*

BS 5871-1, *Specification for the installation and maintenance of gas fires, convector heaters, fire/back boilers and decorative fuel effect gas appliances – Part 1: Gas fires, convector heaters, fire/back boilers and heating stoves (2nd and 3rd family gases)*

BS 5871-2, *Specification for the installation and maintenance of gas fires, convector heaters, fire/back boilers and decorative fuel effect gas appliances – Part 2: Inset live fuel effect gas fires of heat input not exceeding 15 kW, and fire/back boilers (2nd and 3rd family gases)*

BS 6400, Parts 1 to 3, *Specification for installation, exchange, relocation and removal of gas meters with a maximum capacity not exceeding 6 m^3/h*

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