



BSI Standards Publication

**Gas appliances — Combined heat
and power appliance of nominal heat
input inferior or equal to 70 kW**

National foreword

This British Standard is the UK implementation of EN 50465:2015+A1:2019. It supersedes BS EN 50465:2015, which is withdrawn.

The start and finish of text introduced or altered by amendment is indicated in the text by tags. Tags indicating changes to CENELEC text carry the number of the CENELEC amendment. For example, text altered by CENELEC amendment A1 is indicated by A1 A1.

The UK participation in its preparation was entrusted to Technical Committee GEL/105, Fuel cell technologies.

A list of organizations represented on this committee can be obtained on request to its secretary.

The UK committee advises that for the calculation of η_s and η_{son} of cogeneration space heaters the methodology described in the Commission Communication, reference 2014/C 207/02 should be used. This method is robust, scientific, provides a fair comparison across all technologies and is aligned with established methods for assessing and comparing cogeneration performance.

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

© The British Standards Institution 2019
Published by BSI Standards Limited 2019

ISBN 978 0 580 98379 5

ICS 27.070; 97.100.20

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

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 28 February 2015.

Amendments/corrigenda issued since publication

Date	Text affected
31 December 2019	Implementation of CENELEC amendment A1:2019

English Version

Gas appliances - Combined heat and power appliance of nominal heat input inferior or equal to 70 kW

Appareils à gaz - Appareils produisant de la chaleur et de l'électricité combinées dont le débit calorifique nominal est inférieur ou égal à 70 kW

Gasgeräte - Geräte zur Kraft-Wärme-Kopplung mit einer Nennwärmebelastung kleiner oder gleich 70 kW

This European Standard was approved by CENELEC on 29 October 2014. CEN and CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN and CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN and CENELEC member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN and CENELEC members are the national standards bodies and national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom



European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

Contents

Foreword	6
1 Scope	8
2 Normative references	8
3 Terms and definitions	12
4 Classification	27
4.1 Gases/Categories	27
4.2 Mode of air supply and evacuation of combustion products.....	27
4.3 Maximum water side operating pressure	29
4.4 Expansion system	29
5 Constructional requirements	29
5.1 General construction	29
5.2 Use and servicing.....	32
5.3 Connections to the gas and water pipes.....	32
5.4 Soundness	33
5.5 Supply of air and evacuation of combustion products	34
5.6 Requirements for a fan incorporated in a mCHP appliance	35
5.7 Gas/air ratio controls	35
5.8 Air proving	36
5.9 Checking the state of operation	37
5.10 Operational safety in the event of failure of the energy supply for the control systems	37
5.11 Drainage.....	37
5.12 Conversion to different gases	37
5.13 Materials and thickness.....	38
5.14 Thermal insulation.....	44
5.15 Durability against corrosion of metallic combustion product circuits	44
5.16 Requirements for valves as parts of the gas circuit	45
5.17 Combustion products evacuation duct.....	46
5.18 Additional design requirements.....	46
5.19 Gas carrying circuit	47
5.20 Electrical equipment.....	49
5.21 Requirements for adjusting, control and safety devices	50
5.22 Burners.....	56
6 Operational requirements	56
6.1 General requirements	56
6.2 Soundness	57
6.3 Heat input and heat and electrical output	60
6.4 Safety of operation (temperature / limit gas).....	60
6.5 Start / Release and adjusting, control and safety devices (if applicable)	65
6.6 Efficiency	70
6.7 Operation	70
6.8 Combustion	70
6.9 Resistance of materials to pressure.....	71
6.10 Hydraulic resistance	72
6.11 Formation of condensate	72
6.12 Designation and measurement of reference temperatures of flue systems	72
6.13 Mechanical resistance and stability of ducts, terminal and fitting pieces.....	73
6.14 Requirements for plastic in the combustion product evacuation ducts, terminals and fitting pieces for mCHP appliances.....	73
6.15 Requirements for elastomeric seals and elastomeric sealants in the combustion product evacuation ducts, terminals and fitting pieces	77
6.16 Special provisions for mCHP appliances intended to be installed in a partially protected place.....	79
6.17 Sound power level (ErP)..	79
7 Test methods	79
7.1 General test conditions	79
7.2 Soundness	88
7.3 Heat input and heat and electrical output	92

7.4	Safety of operation	94
7.5	Start / Release and adjusting, control and safety devices	109
7.6	Efficiency	114
7.7	Operation	123
7.8	Combustion	123
7.9	Resistance of the materials to pressure	129
7.10	Hydraulic resistance	129
7.11	Formation of condensate	130
7.12	Designation and measurement of reference temperatures of flue systems	131
7.13	Mechanical resistance and stability of ducts, terminal and fitting pieces	131
7.14	Requirements for plastic in the combustion product evacuation ducts, terminals and fitting pieces for mCHP appliances	132
7.15	Tests for elastomeric seals and elastomeric sealants in the combustion product evacuation ducts, terminals and fitting pieces	135
7.16	Special provisions for mCHP appliances intended to be installed in a partially protected place	137
7.17	Sound power level (ErP)	137
8	EMC / electrical requirements	137
8.1	Relevant for the Gas safety	137
8.2	Relevant for the Electrical safety related to the grid with indirect effect to gas safety	137
8.3	Relevant for the EMC	137
9	Marking, installation and operating instructions	138
9.1	mCHP appliance marking	138
9.2	Installation instructions	141
9.3	Operating instructions (i.e. users' instructions)	144
9.4	Conversion instructions	145
9.5	Presentation	145
	Annex A (informative) Different gas connections in common use in the various countries	146
	Annex B (informative) Classification of type B and type C mCHP appliances	147
	Annex C (informative) Composition of the gas circuit	152
	Annex D (informative) Practical method of calibrating the test rig to enable the heat loss D_p to be determined	154
	Annex E (informative) A-deviations	155
	Annex F (informative) Main symbols and abbreviations used	156
	Annex G (informative) Examples for marking	157
	Annex H (informative) Calculation of conversions of NO_x	158
	Annex I (informative) Test rig for the measurement of the stand-by heat losses	159
	Annex J (informative) Market surveillance (ErP)	161
	Annex K (informative) Specific Energy Consumption	163
	Annex CC (normative) Test methods to determine the effects of long-term thermal load, long-term condensate exposure, condensing/ non- condensing cycling and resistance to UV radiation	167
	Annex DD (informative) Variations in gas quality	168
	Annex EE (informative) Calculation of the efficiency for ErP	173
	Annex ZZA (informative) Relationship between this European standard and the essential requirements of Regulation EU 2016/426 aimed to be covered	176
	Annex ZZB (informative) Relationship between this European Standard and the ecodesign requirements of COMMISSION REGULATION (EU) No 813/2013 of 2 August 2013 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for space heaters and combination heaters aimed to be covered	179
	Annex ZZC (informative) Relationship between this European Standard and the energy labelling requirements of COMMISSION DELEGATED REGULATION (EU) No 811/2013 of 18 February 2013 supplementing Directive 2010/30/EU of the European Parliament and of the Council with regard to the energy labelling of space heaters, combination heaters, packages of space heater, temperature control and solar device and packages of combination heater, temperature control and solar device aimed to be covered	182
	Bibliography	184

Figures

Figure 1 – Typical set-up for a fuel cell mCHP appliance.....	16
Figure 2 – Typical set-up for a Stirling engine mCHP appliance	16
Figure 3 – Typical set-up for an internal combustion engine mCHP appliance.....	17
Figure 4 – Example of a sampling probe for the measurement of the products of combustion	81
Figure 5 – Example of the location of the probe for a C type appliance.....	82
Figure 6 – Test rig for the soundness of the gas carrying circuit	87
Figure 7 – Test rig for the soundness of components (pressure drop method).....	88
Figure 8 – Test rig for thermostats: short cut circulation.....	96
Figure 9 – Test rig for thermostats with heat exchanger	97
Figure 10 – Test rig for type C ₁ appliances, equipped with horizontal wind protection device at a vertical wall.....	101
Figure 11 – Test rig for type C ₁ appliances for installation in buildings with tilted roof.....	102
Figure 12 – Test rig for type C ₃ and C ₉ appliances for installation in flat roofed buildings	103
Figure 13 – Test rig for type C ₃ and C ₉ appliances for installation in buildings with tilted roof.....	104
Figure 14 – Measuring points for the stand-by heat losses	116
Figure 15 – Test rig for the determination of hydraulic resistance.....	130
Figure B.1 – Type B ₂	147
Figure B.2 – Type B ₃	147
Figure B.3 – Type C ₁	148
Figure B.4 – Type C ₃	148
Figure B.5 – Type C ₄	149
Figure B.6 – Type C ₅	149
Figure B.7 – Type C ₆	150
Figure B.8 – Type C ₈	150
Figure B.9 – Type C ₉	151
Figure C.1 – Automatic gas shut off valves in the gas supply line for mCHP appliances	152
Figure C.2 – Automatic gas shut off valves in the gas supply line for permanent or alternating mCHP appliances	153
Figure I.1 – Test rig	159
Figure DD.1 – The relation between the (extreme) limit gases (ELG), the reference gas (RG) and the normal distribution gas (NDG) the appliance is designed for. The current standard assumes that the normal distribution is close to the reference gas.....	169
Figure DD.2 – The relation between the (extreme)limit gases (ELG), the reference gas (RG), the distribution limit gases (DLG),and the normal distribution gas(NDG) the appliance is designed for. The DLG are to be considered if the normal distribution gas may vary to a large extent over the lifetime of the appliance.....	171
Figure EE.1 – Equivalent heating efficiency and linear extrapolation from $\eta_{el} = 0,75/CC$	174

Tables

Table 1 – Mechanical properties and chemical compositions of carbon and stainless steels.....	39
Table 2 – Minimum requirements for cast iron.....	39
Table 3 – Parts in aluminium and aluminium alloys.....	40
Table 4 – Parts in copper or copper alloys	40
Table 5 – Minimum thicknesses for rolled parts	40
Table 6 – Nominal minimum thicknesses of mCHP appliance sections.....	40
Table 7 – Weld joints and welding processes.....	41
Table 8 – Metallic combustion products circuit material specifications	45
Table 9 – Composition of the gas circuit.....	49
Table 10 – Maximum admissible leakage rates.....	58
Table 11 – NO _x classes.....	71
Table 12 – Criteria for testing long-term resistance to thermal load.....	74
Table 13 – Criteria for testing long-term resistance to condensate exposure	75
Table 14 – Criteria for testing resistance to condensing/non-condensing cycling.....	76
Table 15 – Group sizes of internal flue diameters	76
Table 16 – Criteria for testing long-term resistance to thermal load.....	77
Table 17 – Criteria for testing-long term resistance to condensate exposure	78
Table 18 – Weighting factor F_{CHP} for weighting $\eta_{eq,CHP}$ in the η_{son} calculation*	118
Table 19 – (CO ₂) _N concentration of the combustion products, in percent	123
Table 20 – Weighting factors	127
Table 21 – Weighting factors	128
Table 22 – Exposure time in weeks at raised temperatures.....	133
Table 23 – Composition of test condensate for corrosion	133
Table 24 – Condensate composition, related to construction classes.....	135
Table 25 – Supplementary markings	140
Table A.1 – Gas connections conditions in common use in the various countries.....	146
Table F.1 – Main symbols and abbreviations used	156
Table G.1 – Category(ies), direct and indirect country(ies) of destination.....	157
Table G.2 – Example 1: Possibilities for the second gas family	157
Table G.3 – Example 2: Possibilities for the third gas family.....	157
Table H.1 – Conversion of the emission value of NO _x for second family gases.....	158
Table H.2 – Conversion of the emission value of NO _x for third family gases.....	158
Table J.1 – Measurement of declared parameters	162
Table EE.1 – Energy outputs and primary energy inputs.	173
Table ZZA.1 – Correspondence between this European standard and Annex I of Regulation	176
Table ZZB.1 – Correspondence between this European Standard and Commission Regulation (Regulation (EU) No 813/2013 of 2 August 2013 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for space heaters and combination heaters [OJEU L239] and Commission’s standardization request M/525/ C(2015) 2626.....	179
Table ZZC.1 – Correspondence between this European Standard and Commission Delegated Regulation (Directive 2010/30/EU of the European Parliament and of the Council with regard to the energy labelling of space heaters, combination heaters, packages of space heater, temperature control and solar device and packages of combination heater, temperature control and solar device [OJEU L239] and Commission’s standardization request M/525/ C (2015) 2626	182

Foreword

This document (EN 50465:2015) has been prepared by CEN/CLC Joint Working Group FCGA, "Fuel cell gas appliances".

The following dates are fixed:

- | | | |
|---|-------|------------|
| • latest date by which this document has to be implemented at national level by publication of an identical national standard or by endorsement | (dop) | 2015-10-29 |
| • latest date by which the national standards conflicting with this document have to be withdrawn | (dow) | 2017-10-29 |

This document supersedes EN 50465:2008.

EN 50465:2015 includes the following significant technical changes with respect to EN 50465:2008:

- inclusion of requirements for „Stirling Engine“ and „Internal Combustion Engine“;
- modification of requirements for fuel cell heating appliances to reflect experience since the first edition;
- partly adaptation to EN 15502-1 and EN 15502-2-1, especially to reflect the new requirements for air proving devices;
- introduction of additional types of combustion air and flue duct systems;
- modification of the total efficiency calculation;
- modifications of NO_x weighting and calculation.

Micro-cogeneration is also known as micro combined heat and power [mCHP]. mCHP is an efficient way to deliver heating, cooling and electricity. It is based on the simultaneous production of electrical and thermal energy, both of which are used. The central and most fundamental principle of mCHP is that in order to maximize the many benefits that arise from it, systems should be based according to the heat demand of the application.

A fuel cell, Stirling engine and internal combustion engine are just some of the significant technologies to be the thermal heart of a mCHP appliance.

mCHP appliances that are already established in the market are used to provide central heating and domestic hot water in residential buildings.

Due to the development of new technology other solutions than those described in this European Standard are possible if these solutions provide at least an equivalent level of safety.

Matters related to quality assurance systems, tests during production, and certificates of conformity of auxiliary devices are not dealt with in this European Standard.

Due to the change in scope to include technologies in addition to fuel cells, the title of this European Standard has been changed from "fuel cell gas heating appliance" into "combined heat and power appliance".

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] shall not be held responsible for identifying any or all such patent rights.

This document has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For the relationship with EU Directive(s) see informative Annex ZZ, which is an integral part of this document. The essential requirements of EC Directive 2009/142/EC relating to "rational use of energy" is defined by the maximum quantity of energy recovered (thermal and electrical energy output) from the gas energy input.

Foreword to amendment A1

This document (EN 50465:2015/A1:2019) has been prepared by CEN/CLC/JTC 17 "Fuel cell gas appliances".

The following dates are fixed:

- latest date by which this document has to be (dop) 2020-05-22
implemented at national level by publication of
an identical national standard or by
endorsement
- latest date by which the national standards (dow) 2022-11-22
conflicting with this document have to be
withdrawn

It should be noted that the following changes have been incorporated in this Amendment:

- a) Adoptions to follow the guidelines for developing harmonized standards ("Vademecum on European standardisation in support of Union legislation and policies (*commission staff working document SWD(2015) 205 final*)" have been implemented, e.g. normative references have been updated to dated references all over the standard by revising Clause 2 with dated references, which apply to all normative references throughout the standard text.
- b) Requirements for risk assessment according to the (EU) 2016/426 (GAR) have been introduced to 5.1.
- c) Requirements for the calculation of the "Annual energy consumption" have been introduced.
- d) Additional requirements for sound power level and additional items for marking, installation and operating instructions have been introduced, which are addressed by the 2009/125/EC (ErP).
- e) Additional information for the market surveillance have been introduced (Annex J), which are addressed by the ErP.
- f) An informative Annex K has been introduced, which is giving information for definition and test methods for the "Specific Energy Consumption", it is recommended to be used as a basis for future review of the Energy Labelling Regulation.
- g) Annex ZZA concerning (EU) 2016/426 (GAR) and Annexes ZZB and ZZC concerning regulations 811/2013 and 813/2013 under Directive 2010/30/EU have been introduced.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC shall not be held responsible for identifying any or all such patent rights.

For the relationship with EU Directive(s) see informative Annexes ZZA, ZZB and ZZC, which are an integral part of this document.

1 Scope

A1 This document specifies the requirements and test methods for the construction, safety, fitness for purpose, rational use of energy, sound power measurement and together with requirements for the marking and advice on the end of life disposal of a micro combined heat and power appliance; hereafter referred to as “mCHP appliance”. **A1**

This European Standard applies to mCHP appliances of types B₂₂, B₂₃, B₃₂, B₃₃, B₅₂, B₅₃, C₁, C₃, C₄₂, C₄₃, C₅₂, C₅₃, C₆₂, C₆₃, C₈₂, C₈₃ and C₉ based on the classifications of CEN/TR 1749:

- that use one or more supplied gases of the three gas families at the pressures stated in EN 437,
- where the temperature of the heat transfer fluid of the heating system (heating water circuit) does not exceed 105 °C during normal operation,
- where the maximum operating pressure in the
 - heating water circuit does not exceed 6 bar,
 - domestic hot water circuit (if installed) does not exceed 10 bar,
- which are either intended to be installed indoors or outdoors in a partially protected place,
- which are intended to produce hot water either by the instantaneous or storage principle,
- which have a maximum heat input (based on net calorific value) not exceeding 70 kW,
- which are designed for sealed or open water systems.

NOTE 1 For applications where the maximum allowable water temperature exceeds 110 °C or where volume multiplied by maximum allowable pressure exceeds 50 bar litres, further requirements may be necessary to comply with the essential requirements of Directive 97/23/EC (Pressure Equipment Directive (PED)).

NOTE 2 For mCHP appliances with constructions that might not be fully covered by this European Standard or by another specific standard, the risk associated with the alternative construction will be assessed.

NOTE 3 prEN 13203-4 will specify the assessment of energy consumption for domestic hot water production of gas combined heat and power appliances (mCHP).

This European Standard does not contain the requirements necessary for appliance capable of producing electrical energy without using the thermal energy.

This European Standard does not cover all the requirements for mCHP appliances that are intended to be connected to gas grids where the quality of the distributed gas is likely to vary to a large extent over the lifetime of the appliance (see Annex DD).

2 Normative references

A1 The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

NOTE This standard uses only dated references as for undated references in the main body of the standard, the version referred to in this clause applies.

EN 88-1:2011+A1:2016, *Pressure regulators and associated safety devices for gas appliances - Part 1: Pressure regulators for inlet pressures up to and including 50 kPa*

EN 125:2010+A1:2015, *Flame supervision devices for gas burning appliances - Thermoelectric flame supervision devices*

EN 126:2012, *Multifunctional controls for gas burning appliances*

EN 161:2011+A3:2013, *Automatic shut-off valves for gas burners and gas appliances*

EN 298:2012, *Automatic burner control systems for burners and appliances burning gaseous or liquid fuels*

EN 437:2003+A1:2009, *Test gases - Test pressures - Appliance categories*

- EN 513:1999, *Unplasticized polyvinylchloride (PVC-U) profiles for the fabrication of windows and doors - Determination of the resistance to artificial weathering*
- EN 549:1994, *Rubber materials for seals and diaphragms for gas appliances and gas equipment*
- EN 573-1:2004, *Aluminium and aluminium alloys - Chemical composition and form of wrought products - Part 1: Numerical designation system*
- EN 1057:2006+A1:2010, *Copper and copper alloys - Seamless, round copper tubes for water and gas in sanitary and heating applications*
- EN 1092-1:2007+A1:2013, *Flanges and their joints — Circular flanges for pipes, valves, fittings and accessories, PN designated — Part 1: Steel flanges*
- EN 1092-2:1997, *Flanges and their joints - Circular flanges for pipes, valves, fittings and accessories, PN designated - Part 2: Cast iron flanges*
- EN 1092-3:2003, *Flanges and their joints - Circular flanges for pipes, valves, fittings and accessories, PN designated - Part 3: Copper alloy flanges*
- EN 1092-3:2003/AC:2007, *Flanges and their joints - Circular flanges for pipes, valves, fittings and accessories, PN designated - Part 3: Copper alloy flanges*
- EN 1092-4:2002, *Flanges and their joints - Circular flanges for pipes, valves, fittings and accessories, PN designated - Part 4: Aluminium alloy flanges*
- CR 1404:1994, *Determination of emissions from appliances burning gaseous fuels during type-testing*
- EN 1561:2011, *Founding - Grey cast irons*
- EN 1856-1:2009, *Chimneys - Requirements for metal chimneys - Part 1: System chimney products*
- EN 1856-2:2009, *Chimneys - Requirements for metal chimneys - Part 2: Metal flue liners and connecting flue pipes*
- EN 10029:2010, *Hot-rolled steel plates 3 mm thick or above - Tolerances on dimensions and shape*
- EN 10088-1:2014, *Stainless steels - Part 1: List of stainless steels*
- EN 10226-1:2004, *Pipe threads where pressure tight joints are made on the threads - Part 1: Taper external threads and parallel internal threads - Dimensions, tolerances and designation*
- EN 10226-2:2005, *Pipe threads where pressure tight joints are made on the threads - Part 2: Taper external threads and taper internal threads - Dimensions, tolerances and designation*
- EN 12067-2:2004, *Gas/air ratio controls for gas burners and gas burning appliances - Part 2: Electronic types*
- EN 13203-1:2015, *Gas fired domestic appliances producing hot water - Part 1: Assessment of performance of hot water deliveries*
- EN 13216-1:2004, *Chimneys - Test methods for system chimneys - Part 1: General test methods*
- EN 13501-1:2007+A1:2009, *Fire classification of construction products and building elements - Part 1: Classification using data from reaction to fire tests*
- EN 13611:2015, *Safety and control devices for burners and appliances burning gaseous and/or liquid fuels - General requirements*
- EN 13611:2015/AC:2016, *Safety and control devices for burners and appliances burning gaseous and/or liquid fuels - General requirements*
- EN 14459:2015, *Safety and control devices for burners and appliances burning gaseous or liquid fuels - Control functions in electronic systems - Methods for classification and assessment*
- EN 14471:2013+A1:2015, *Chimneys - System chimneys with plastic flue liners - Requirements and test methods*

EN 15036-1:2006, *Heating boilers - Test regulations for airborne noise emissions from heat generators - Part 1: Airborne noise emissions from heat generators*

EN 50438:2013, *Requirements for micro-generating plants to be connected in parallel with public low-voltage distribution networks*

EN 50549-1:2018, *Requirements for generating plants to be connected in parallel with distribution networks – Part 1: Connection to a LV distribution network – Generating plants up to and including Type B*

EN 50549-2:2018, *Requirements for generating plants to be connected in parallel with distribution networks – Part 2: Connection to a MV distribution network - Generating plants up to and including Type B*

EN 55014-1:2006, *Electromagnetic compatibility - Requirements for household appliances, electric tools and similar apparatus - Part 1: Emission*

EN 55014-1:2006/A1:2009, *Electromagnetic compatibility - Requirements for household appliances, electric tools and similar apparatus - Part 1: Emission*

EN 55014-1:2006/A2:2011, *Electromagnetic compatibility - Requirements for household appliances, electric tools and similar apparatus - Part 1: Emission*

EN 55014-2:2015, *Electromagnetic compatibility - Requirements for household appliances, electric tools and similar apparatus - Part 2: Immunity - Product family standard*

EN 60335-1:2012, *Household and similar electrical appliances - Safety - Part 1: General requirements*

EN 60335-2-102:2016, *Household and similar electrical appliances - Safety - Part 2-102: Particular requirements for gas, oil and solid-fuel burning appliances having electrical connections*

EN 60529:1991, *Degrees of protection provided by enclosures (IP Code)*

EN 60529:1991/A1:2009, *Degrees of protection provided by enclosures (IP Code) (IEC 60529:1989/A1:1999)*

EN 60529:1991/A2:2013, *Degrees of protection provided by enclosures (IP Code)*

EN 60730-2-9:2010, *Automatic electrical controls for household and similar use - Part 2-9: Particular requirements for temperature sensing controls*

EN 61000-3-2:2014, *Electromagnetic compatibility (EMC) - Part 3-2: Limits - Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)*

EN 61000-3-3:2013, *Electromagnetic compatibility (EMC) - Part 3-3: Limits - Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current ≤ 16 A per phase and not subject to conditional connection*

EN 61000-3-11:2000, *Electromagnetic compatibility (EMC) - Part 3-11: Limits - Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems - Equipment with rated current ≤ 75 A and subject to conditional connection*

EN 61000-3-12:2011, *Electromagnetic compatibility (EMC) - Part 3-12: Limits - Limits for harmonic currents produced by equipment connected to public low-voltage systems with input current > 16 A and ≤ 75 A per phase*

EN 61000-6-1:2007, *Electromagnetic compatibility (EMC) - Part 6-1: Generic standards - Immunity for residential, commercial and light-industrial environments*

EN 61000-6-3:2007, *Electromagnetic compatibility (EMC) - Part 6-3: Generic standards - Emission standard for residential, commercial and light-industrial environments*

EN 61000-6-3:2007/A1:2011, *Electromagnetic compatibility (EMC) - Part 6-3: Generic standards - Emission standard for residential, commercial and light-industrial environments*

EN 62282-3-100:2012, *Fuel cell technologies - Part 3-100: Stationary fuel cell power systems - Safety*

EN ISO 178:2010, *Plastics - Determination of flexural properties (ISO 178:2010)*

EN ISO 178:2010/A1:2013, *Plastics - Determination of flexural properties (ISO 178:2010/A1:2013)*

- EN ISO 179-1:2010, *Plastics - Determination of Charpy impact properties - Part 1: Non-instrumented impact test (ISO 179-1:2010)*
- EN ISO 228-1:2003, *Pipe threads where pressure-tight joints are not made on the threads - Part 1: Dimensions, tolerances and designation (ISO 228-1:2000)*
- EN ISO 527-1:2012, *Plastics - Determination of tensile properties - Part 1: General principles (ISO 527-1:2012)*
- EN ISO 527-2:2012, *Plastics - Determination of tensile properties - Part 2: Test conditions for moulding and extrusion plastics (ISO 527-2:2012)*
- EN ISO 1183-1:2012, *Plastics - Methods for determining the density of non-cellular plastics - Part 1: Immersion method, liquid pycnometer method and titration method (ISO 1183-1:2012)*
- EN ISO 1183-2:2004, *Plastics - Methods for determining the density of non-cellular plastics - Part 2: Density gradient column method (ISO 1183-2:2004)*
- EN ISO 1183-3:1999, *Plastics - Methods for determining the density of non-cellular plastics - Part 3: Gas pycnometer method (ISO 1183-3:1999)*
- EN ISO 2553:2013, *Welding and allied processes - Symbolic representation on drawings - Welded joints (ISO 2553:2013)*
- EN ISO 3166-1:2014, *Codes for the representation of names of countries and their subdivisions - Part 1: Country codes (ISO 3166-1:2013)*
- EN ISO 4063:2010, *Welding and allied processes - Nomenclature of processes and reference numbers (ISO 4063:2009, Corrected version 2010-03-01)*
- EN ISO 8256:2004, *Plastics - Determination of tensile-impact strength (ISO 8256:2004)*
- EN ISO 9969:2016, *Thermoplastics pipes - Determination of ring stiffness (ISO 9969:2016)*
- EN ISO 16852:2016, *Flame arresters - Performance requirements, test methods and limits for use (ISO 16852:2016)*
- ISO 7-1:1994, *Pipe threads where pressure-tight joints are made on the threads — Part 1: Dimensions, tolerances and designation*
- ISO 37:2017, *Rubber, vulcanized or thermoplastic — Determination of tensile stress-strain properties*
- ISO 188:2011, *Rubber, vulcanized or thermoplastic — Accelerated ageing and heat resistance tests*
- ISO 262:1998, *ISO general purpose metric screw threads — Selected sizes for screws, bolts and nuts*
- ISO 815-1:2014, *Rubber, vulcanized or thermoplastic — Determination of compression set — Part 1: At ambient or elevated temperatures*
- ISO 815-2:2014, *Rubber, vulcanized or thermoplastic — Determination of compression set — Part 2: At low temperatures*
- ISO 857-2:2005, *Welding and allied processes — Vocabulary — Part 2: Soldering and brazing processes and related terms*
- ISO 1817:2015, *Rubber, vulcanized or thermoplastic — Determination of the effect of liquids*
- ISO 2781:2008, *Rubber, vulcanized or thermoplastic — Determination of density*
- ISO 6914:2013, *Rubber, vulcanized or thermoplastic — Determination of ageing characteristics by measurement of stress relaxation in tension*
- ISO 7619-1:2010, *Rubber, vulcanized or thermoplastic — Determination of indentation hardness — Part 1: Durometer method (Shore hardness)*
- ISO 7619-2:2010, *Rubber, vulcanized or thermoplastic — Determination of indentation hardness — Part 2: IRHD pocket meter method *

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

NOTE Table F.1 summarizes the main symbols and abbreviations used in this European Standard.

3.1

reference conditions

these correspond to 15 °C and 1 013,25 mbar, unless otherwise specified

Note 1 to entry: mbar = 10² Pa.

[SOURCE: EN 437: 2003+A1:2009, 3.9]

3.2

combustible gases

3.2.1

test gases

gases intended for the verification of the operational characteristics of gas appliances. They consist of reference gases and limit gases

[SOURCE: EN 437:2003+A1:2009, 3.2]

3.2.2

reference gases

test gases with which appliances operate under nominal conditions when they are supplied at the corresponding normal pressure

[SOURCE: EN 437:2003+A1:2009, 3.3]

3.2.3

limit gases

test gases representative of the extreme variations in the characteristics of the gases for which appliances have been designed

[SOURCE: EN 437:2003+A1:2009, 3.4]

3.2.4

calorific value

quantity of heat produced by the complete combustion, at a constant pressure equal to 1 013,25 mbar, of a unit volume or mass of gas, the constituents of the combustible mixture being taken at reference conditions and the products of combustion being brought back to the same conditions

A distinction is made between:

- the gross calorific value H_g : the water produced by combustion is assumed to be condensed;
- the net calorific value H_n : the water produced by combustion is assumed to be in the vapour state

Note 1 to entry: The calorific value is expressed:

- either in megajoules per cubic metre (MJ/m³) of dry gas under the reference conditions;
- or in megajoules per kilogram (MJ/kg) of dry gas.

[SOURCE: EN 437:2003+A1:2009, 3.11]

3.2.5

relative density

d

ratio of the masses of equal volumes of dry gas and dry air under the same conditions of temperature and pressure: 15 °C or 0 °C and 1 013,25 mbar

[SOURCE: EN 437:2003+A1:2009, 3.10]

3.2.6

Wobbe index

gross Wobbe index: W_g ; **net Wobbe index:** W_i

ratio of the calorific value of a gas per unit volume to the square root of its relative density under the same reference conditions. The Wobbe index is said to be gross or net according to whether the calorific value used is the gross or net calorific value

Note 1 to entry: The Wobbe indices are expressed:

- either in megajoules per cubic metre (MJ/m³) of dry gas under reference conditions,
- or in megajoules per kilogram (MJ/kg) of dry gas.

[SOURCE: EN 437:2003+A1:2009, 3.12]

3.2.7

gas pressure

3.2.7.1

general

all the pressures are static pressures of the moving gas, relative to the atmospheric pressure, measured at right angles to the direction of the flow of the gas

Note 1 to entry: Symbol: p . The gas pressures used are expressed in millibars (mbar) 1 mbar = 10² Pa.

3.2.7.2

test pressures

gas pressures used to verify the operational characteristics of gas appliances, consisting of normal and limit pressures

[SOURCE: EN 437:2003+A1:2009, 3.5, modified]

3.2.7.3

normal pressure

p_n

pressure under which the appliances operate in nominal conditions when they are supplied with the corresponding reference gas

[SOURCE: EN 437:2003 + A1:2009, 3.6]

3.2.7.4

limit pressures

maximum pressure: p_{max} ; **minimum pressure:** p_{min}

pressures representative of the extreme variations in the appliance supply conditions

[SOURCE: EN 437:2003+A1:2009, 3.7]

3.2.7.5

pressure couple

combination of two distinct gas distribution pressures applied by reason of the significant difference existing between the Wobbe indices within a single gas family or group in which

- the higher pressure corresponds only to gases of low Wobbe index;
- the lower pressure corresponds to gases of high Wobbe index

[SOURCE: EN 437:2003+A1:2009, 3.8]

3.3

Cogeneration

CHP

simultaneous generation of thermal and electrical energy in one process

Note 1 to entry: CHP= combined heat and power

3.3.1 mCHP

condensing or non-condensing CHP appliance with a maximum electrical output power below 50 kW

Note 1 to entry: As defined by Directive 2012/27/EC.

Note 2 to entry: mCHP= microCHP.

3.3.2 mCHP appliance

appliance which is either delivered as a complete package or specified as the complete package to deliver safely and effectively the heating, electrical power and where applicable the domestic hot water service claimed, comprising as relevant:

- primary heat & power generator (PH&PG);
- supplementary heat generator;
- flue ducts;
- thermal store

3.3.3 mCHP appliance technologies and its sub functions

3.3.3.1 fuel cell mCHP appliance

appliance that includes a fuel cell which produces simultaneous thermal energy and electrical energy (electrochemical reaction), consisting typically of distinct parts

Note 1 to entry: See Figure 1.

3.3.3.2 Stirling engine mCHP appliance

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; consisting typically of distinct parts

Note 1 to entry: See Figure 2.

3.3.3.3 internal combustion engine mCHP appliance

appliance that includes an internal combustion engine module which generates mechanical and thermal energy and a generator to convert mechanical energy into electrical energy, the remaining energy being transferred to the thermal management system; consisting typically of distinct parts

Note 1 to entry: See Figure 3.

3.3.3.4 Sub functions

3.3.3.4.1

primary heat & power generator

preferential heat generator producing thermal and electrical energy comprising

- for fuel cell mCHP appliances: fuel processing system, fuel cell module and power conditioning and chp-control system, see Figure 1
- for Stirling Engine mCHP appliances: Engine burner, Stirling Engine module, power conditioning and chp-control system, see Figure 2
- for internal combustion engine mCHP appliances: internal combustion engine, power generator and power conditioning and chp-control system, see Figure 3

3.3.3.4.2 fuel processing system

chemical processing equipment including any associated heat exchangers and controls required to convert input fuel to a composition suitable for the fuel cell stacks

[SOURCE: IEC/TS 62282-1:2010, 2.2, modified]

3.3.3.4.3

fuel cell module

assembly including one or more fuel cell stack(s) other main components intended to be integrated into the fuel cell gas heating appliance

Note 1 to entry: A fuel cell module is comprised of the following main components: one or more fuel cell stack(s), piping system for conveying fuels, oxidants and exhausts, electrical connections for the power delivered by the stack(s) and means for monitoring and/or control. Additionally, a fuel cell module may comprise: means for conveying additional fluids (e.g. cooling media, inert gas), means for detecting normal and/or abnormal operating conditions, enclosures or pressure vessels and module ventilation systems.

[SOURCE: IEC/TS 62282-1:2010, 3.48, modified]

3.3.3.4.4

Internal combustion engine

mechanism delivering shaft power by the combustion of fuel in one or more cylinders in which working pistons reciprocate

3.3.3.4.5

power conditioning and chp-control system

equipment used to change electrical voltage level or waveform, or otherwise alter or regulate the electrical output of the primary heat & power generator to make it suitable and safe for export to other components within or outside the appliance including controls used to operate the primary heat & power generator such as gas valves, safety controls and internal cooling pumps

3.3.3.4.6

supplementary heat generator

non-preferential heat source providing peak load

3.3.3.4.7

thermal management

internal system that manages the transfer of the thermal energy of the 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 domestic hot water

Note 1 to entry: The source of the thermal energy of the appliance could be e.g. for a fuel cell mCHP appliance the fuel processing system, fuel cell module or supplementary heat generator.

3.3.3.4.8

support controls

internal control system associated with the supplementary heat generator and the thermal management

Note 1 to entry: The controls associated with the primary heat & power generator are not part of the “support controls”.

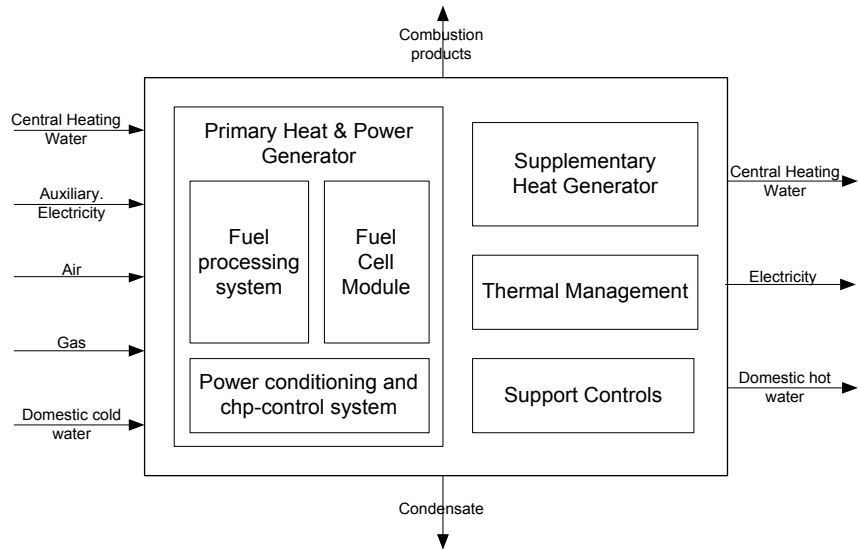


Figure 1 – Typical set-up for a fuel cell mCHP appliance

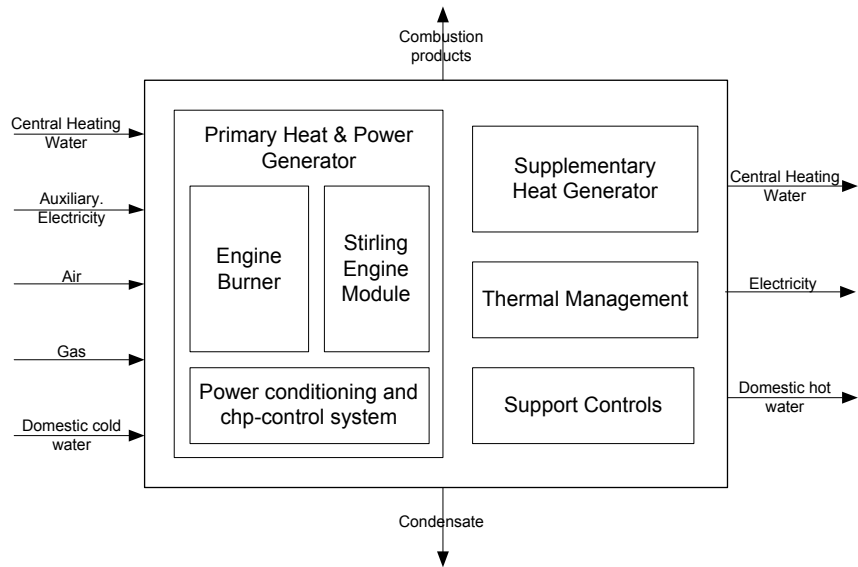


Figure 2 – Typical set-up for a Stirling engine mCHP appliance

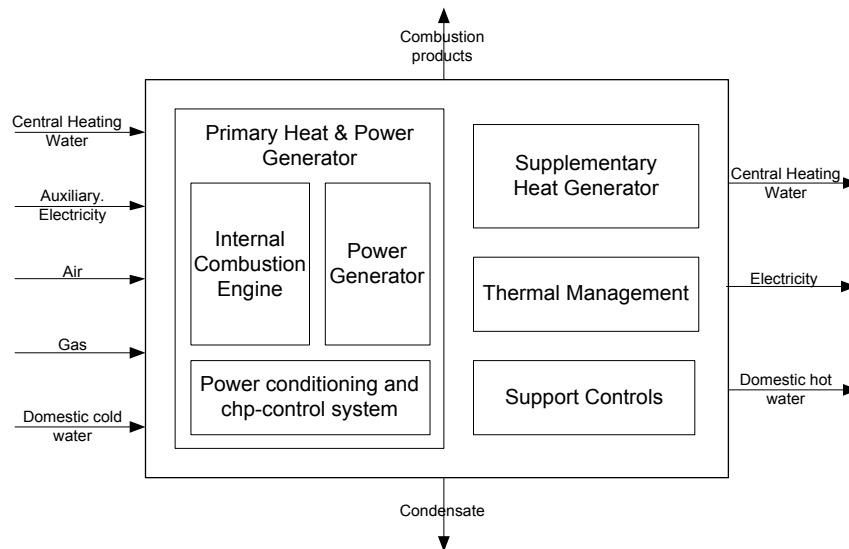


Figure 3 – Typical set-up for an internal combustion engine mCHP appliance

3.3.3.5 condensing mCHP

mCHP appliance in which, under normal operating conditions and at certain operating water temperatures, the water vapour in the combustion products is partially condensed, in order to make use of the latent heat of this water vapour for heating purposes

3.3.3.6 combination mCHP appliance

mCHP appliance designed both for central heating and for the production of domestic hot water

Note 1 to entry: Depending on its type of domestic hot water production, the combination mCHP appliance is classified in accordance with the appliance instruction as instantaneous type or storage type.

3.4 constituent parts of a mCHP appliance

3.4.1 general

3.4.1.1 gas inlet connection

part of the mCHP appliance intended to be connected to the gas supply

3.4.1.2 gas circuit

assembly of parts of the mCHP appliance that carry or contain the supplied gas between the gas inlet connection and the outlet of the safety shut-off valves

3.4.1.3 gas carrying circuit

assembly of parts of the mCHP appliance that carry or contain supplied gas or process gas

Note 1 to entry: This circuit includes the gas circuit.

3.4.1.4 restrictor

device which is placed in the gas carrying circuit so as to create a pressure drop and thus bring the gas pressure at a burner or a gas mixture equipment to a predetermined value for a given supply pressure and a given rate

3.4.1.5 injector

component that admits gas into a burner or into an internal combustion engine

3.4.1.6**gas rate adjuster**

component allowing the gas rate of a burner or a gas mixture equipment to be brought to a predetermined value according to the supply conditions

Note 1 to entry: The action of operating this device is called “adjustment of the gas rate”.

3.4.1.7**range-rating device**

component on the mCHP appliance intended to be used by the installer to adjust the nominal heat input of the mCHP appliance within the range of maximum and minimum heat inputs stated in the technical specifications/instructions, to suit the actual heat requirements of the installation

3.4.1.8**sealing an adjuster or control device**

arrangements made to make evident any attempt to change the set adjustment (e.g. breakage of the device or the sealing material)

Note 1 to entry: A sealed adjuster or control device is considered to be non-existent.

3.4.1.9**main burner**

any burner that is intended to ensure the thermal function of the mCHP appliance, and is generally called “the burner”

Note 1 to entry: The mCHP appliance may comprise more than one main burner, e.g. serving the primary heat & power generator and the supplementary heat generator.

3.4.1.10**catalytic burner**

burner (oxidizer) in which the gas and a quantity of air at least equal to that theoretically necessary for complete combustion are mixed before the reaction zone, with a flameless combustion taking place in the reaction zone which is supported by catalysts

3.4.1.11**ignition device**

any means (e.g. flame, electrical, etc.) used to ignite the gas admitted to the burner(s) or to the internal combustion engine

3.4.1.12**ignition burner**

burner intended to ignite another burner; recognised ignition burners are:

3.4.1.12.1**permanent ignition burner**

ignition burner that operates continuously throughout the whole period that the relevant part of the mCHP appliance is in use

3.4.1.12.2**alternating ignition burner**

ignition burner that is extinguished as soon as the ignition of the burner it is intended to ignite is effected and re-ignites from the flame of the burner it has ignited just before the latter is extinguished

3.4.2**constituent parts specific to a fuel cell mCHP appliance****3.4.2.1****process gas**

gas, transformed from supplied gas to a gas containing predominantly hydrogen

3.4.2.2

anode

electrode at which fuel oxidation takes place by the removal of electrons from the fuel to the electric load, followed by the release of oxidized fuel products

[SOURCE: IEC/TS 62282-1:2010, 3.2, modified]

3.4.2.3

fuel cell stack

assembly of cells, separators, cooling plates, manifolds and a supporting structure that electrochemically converts, typically, hydrogen rich gas and air reactants to DC power, heat and other reaction products

[SOURCE: IEC/TS 62282-1:2010, 3.50]

3.5

air supply and combustion products evacuation

3.5.1

combustion circuit

circuit including the air supply duct and the combustion products circuit

3.5.2

combustion products circuit

circuit including the combustion chamber, the heat exchanger, the combustion products evacuation duct and either the fitting piece or the connection to the terminal, if any

3.5.3

combustion chamber

enclosure inside which combustion of the air-gas mixture takes place

3.5.4

air supply and combustion products evacuation ducts

means for transporting combustion air to the burner or internal combustion engine and the combustion products to the terminal or fitting piece

Note 1 to entry: It is necessary to distinguish between

- completely surrounded ducts: the combustion products evacuation duct is surrounded by combustion air throughout its length,
- separate ducts: the combustion products evacuation duct and the combustion air supply duct are neither concentric nor completely surrounded ducts.

3.5.5

terminal

part of the combustion circuit fitted external to the building which has the function of the air supply inlet and/or combustion products outlet of the appliance

3.5.6

terminal guard

device that protects the terminal from physical damage from outside influences

3.5.7

fitting piece

device which allows the fitting of

- a type C₄ mCHP appliance via its two ducts to a common duct system,
- a type C₆ mCHP appliance to a separately certified and marketed system for the supply of combustion air and the discharge of combustion products,
- a type C₈ mCHP appliance via one of its ducts to a single or common duct system that is part of the building
- the air supply duct to a chimney that is part of the building for type C₉ mCHP appliances

Note 1 to entry: The fitting piece may be part of the mCHP appliance or of the air supply and/or combustion products evacuation system.

3.5.8**backflow valve**

valve to prevent flue gas backflow

3.6**adjusters, monitoring and safety devices****3.6.1****pressure regulator**

device which maintains the downstream pressure constant to within fixed limits independent of variations, within a given range, of the upstream pressure and the gas rate

3.6.2**adjustable pressure regulator**

pressure regulator fitted with a means of adjusting the downstream pressure

Note 1 to entry: This means is considered as an “adjusting device”.

3.6.3**water rate monitoring device**

device that shuts off the gas supply to the main burner or to the internal combustion engine when the water rate through the mCHP appliance is less than a predetermined value and automatically reopens the gas supply when the water rate reaches at least this value

3.6.4**flame supervision device**

device that, in response to a signal from a flame detector, keeps the gas supply open and shuts it off in the absence of the supervised flame

3.6.5**control thermostat**

device enabling the water temperature to be kept automatically within a given range at a predetermined value

3.6.6**adjustable control thermostat**

control thermostat that permits the user to obtain setting temperatures between a minimum and a maximum value

3.6.7**limit thermostat**

device that causes a shut off of the gas supply when a limit value of the temperature is reached, and automatically enables a new start-up sequence when the temperature returns below the fixed limit

3.6.8**safety temperature limiter**

device that causes safety shutdown and non-volatile lockout so as to prevent a gas or a water temperature exceeding a pre-set limit

3.6.9**overheat cut-off device**

device that causes safety shutdown and non-volatile lockout before the mCHP appliance is damaged and/or before safety is put in question

3.6.10**control knob**

component intended to be moved by hand in order to act on a mCHP appliance control (e.g. tap, thermostat, etc.)

3.6.11

flame detector

device which detects and signals the presence of a flame

Note 1 to entry: It may consist of a flame sensor, an amplifier and a relay for signal transmission. These parts, with the possible exception of the actual flame sensor, may be assembled in a single housing for use in conjunction with a programming unit.

3.6.12

flame signal

signal given by the flame detector, normally when its sensor reacts to a flame

3.6.13

programming unit

device that reacts to impulses from control and safety systems, gives control commands, controls the start-up programme, supervises burner or internal combustion engine operation and causes controlled shutdown, safety shutdown or lockout, if necessary. The programming unit follows a predetermined sequence of actions and operates in conjunction with a flame detector and/or combustion detection device

3.6.14

automatic burner / engine control system

automatic burner control system

automatic engine control system

system that comprises a programming unit and the flame detector and/or combustion detection function

Note 1 to entry All the functions of an automatic control system may be assembled in one or more housings.

3.6.15

start

action which causes the mCHP appliance to leave its start position and the predetermined programme of the programming unit to commence

3.6.16

programme

sequence of control operations determined by the programming unit, involving switching on, supervising and switching off burner / internal combustion engine

3.6.17

automatic shut-off valve

device that automatically opens, closes or varies a rate on a signal from the automatic burner / engine control system

Note 1 to entry Automatic valves are classified in accordance with EN 161 into classes A, B, C, D and J.

3.6.18

multifunctional control

device having two or more controls and/or control function(s) whereby the functional parts cannot operate if separated

3.6.19

closure member

movable part of the valve or the thermoelectric device that opens, varies or shuts off the gas path

3.6.20

breather hole

orifice that allows atmospheric pressure to be maintained in a compartment of variable volume

3.6.21

diaphragm

flexible component that operates a valve by means of a force resulting from a pressure difference

3.6.22

external soundness

soundness, with respect to the atmosphere, of an enclosure containing gas

3.6.23**internal soundness**

soundness of a closure member in the closed position and isolating an enclosure containing gas from another enclosure or from the outlet of the valve

3.6.24**fault tolerating time**

time between the occurrence of a fault and the shut-down of the burner / internal combustion engine which is tolerated by the application without creating a hazardous situation

3.6.25**frost protection system**

system that actively protects the water in the mCHP appliance against freezing

Note 1 to entry An anti-freeze solution is not considered as an active frost protective system.

3.6.26**maximum allowable working temperature**

temperature the material can withstand over a long period of time under working condition

3.6.27**remote control function**

function providing automatic and normal operation by means of a control intended to be actuated with or without line of sight of the mCHP appliance, e.g. through

- a) communication lines/protocols,
- b) additional hardware and/or software,
- c) ultra-sonic,
- d) infrared (IR)/radio frequency (RF) transmission,
- e) all kind of combinations of a) to c) via the internet, e.g. modems, portable telephones

3.6.28**remote control**

device that performs the remote control function by wires or wireless connection, with or without line of sight of the mCHP appliance

3.6.29**remote reset**

device that performs a specific remote control function, being reset from lock-out to allow a restart attempt

3.6.30**thermal store**

heat reservoir sited mainly in heating water, as opposed to the domestic hot water storage in the tank

3.6.31**tank**

reservoir of combination mCHP appliances for domestic hot water

3.7**operation of a mCHP appliance****3.7.1****heat input**

Q

quantity of energy used in unit time corresponding to the volumetric or mass flow rates, the calorific value used being either the net or gross calorific value

Note 1 to entry: The heat input is expressed in kilowatt (kW).

[SOURCE: EN 437:2003+A1:2009, 3.13, modified]

3.7.2**nominal heat input** Q_n

value of the heat input declared in the technical specifications/instructions

Note 1 to entry: The nominal heat input is expressed in kilowatt (kW).

Note 2 to entry: Range rated mCHP appliances operate at a nominal heat input between the maximum and minimum adjustable heat input. Modulating mCHP appliances operate between the nominal and minimum controlled heat inputs.

[SOURCE: EN 437:2003+A1:2009, 3.14]

3.7.3**ignition rate** Q_{IGN}

average heat input during the ignition safety time

Note 1 to entry: The ignition rate is expressed in kilowatt (kW).

3.7.4**outputs****3.7.4.1****nominal output**

useful output in kW stated in the technical specifications/instructions, corresponding to the operation of the mCHP appliance in a nominal (e.g. 80 °C/60 °C) water temperature regime

3.7.4.2**useful heat output** P_{th}

heat transmitted to the heat transfer fluid in kW

3.7.4.3**nominal heat output** P_{th_n}

useful heat output as stated in the technical specifications/instructions in kW

3.7.4.4**maximum and minimum electric power output**

net AC electricity transmitted to low voltage grid in kW

Note 1 to entry: The symbol is $P_{\text{el}_{\text{max}}}$ resp. $P_{\text{el}_{\text{min}}}$.**3.7.4.5****net AC electric power output** P_{el}

electric power output of the primary heat & power generator

Note 1 to entry: The net AC electric power output is expressed in kilowatt (kW).

3.7.4.6**nominal electric power output** P_{el_n}

net AC electric power output stated in the technical specifications/instructions

3.7.4.7**net AC electric energy** W_{el}

electric energy output of the primary heat & power generator

Note 1 to entry: The net AC electric energy is expressed in kilowatt hours (kWh).

3.7.4.8**electric auxiliary energy**

electric energy consumed by the support controls (e.g. pump, fan, valves, control unit)

3.7.5**overall efficiency**

ratio of the useful heat output and the net AC electric power output to the heat input, expressed in per cent

3.7.6**combustion****3.7.6.1****complete combustion**

combustion with no more than traces of combustible constituents (hydrogen, hydrocarbons, carbon monoxide, carbon etc.) in the combustion products

3.7.6.2**incomplete combustion**

combustion at which at least one combustible constituent is present in significant proportions in the combustion products

3.7.7**flame stability**

characteristics of flames that remain on the burner ports or in the flame retention zone

3.7.8**flame lift**

phenomenon characterized by the total or partial lifting of the base of the flame away from the burner port or the flame retention zone

3.7.9**light-back**

phenomenon characterized by the entry of a flame into the body of the burner

3.7.10**sooting**

phenomenon appearing during incomplete combustion and characterized by deposits of soot on the surfaces or parts in contact with the combustion products or with the flame

3.7.11**yellow tipping**

phenomenon characterized by the yellowing of the tip of the blue cone of an aerated flame

3.7.12**ignition safety time**

T_{SA}

time that elapses between the order to open and the order to close the gas supply to the burner / internal combustion engine in the event of ignition not taking place

3.7.13**maximum ignition safety time**

$T_{SA,max}$

ignition safety time measured under the least favourable conditions of ambient temperature and variation in supply voltage

3.7.14**extinction safety time**

T_{SE}

time that elapses between extinction of the supervised flame and the order to shut off the gas supply to the burner / internal combustion engine

3.7.15**ignition restoration**

automatic process by which, following flame failure, the ignition device is switched on again without total interruption of the gas supply

3.7.16**recycling**

automatic process by which, after loss of flame during operation, the gas supply is interrupted and the full start procedure is re-initiated automatically

3.7.17**controlled shutdown**

process by which a control device (on the mCHP appliance or external to it) causes the gas supply to the burner / internal combustion engine to be stopped immediately; the mCHP appliance returns to its start position

3.7.18**safety shutdown**

process which is effected immediately following the response of a protection device or the detection of a fault and puts the burner(s) / internal combustion engine out of operation such as to maintain a safe condition and avoid damage to the appliance; the resulting state of the system is defined by deactivated terminals for the shut-off valves and the ignition device

3.7.19**locking out**

complete interruption of the gas supply with lockout

3.7.20**non-volatile lockout**

shutdown condition such that a restart can only be accomplished by a manual reset

3.7.21**volatile lockout**

shutdown condition such that a restart can also be accomplished by restoration of the electricity supply after its loss

3.7.22**purge**

mechanical introduction of air into the combustion circuit in order to displace any gas/air mixture, which could remain there. A distinction is made between

- pre-purge: the purge that takes place between the start command and the ignition device being energized,
- post-purge: the purge that is carried out after burner shutdown

3.7.23**pre-purge time**

period during which pre-purge takes place

Note 1 to entry: Definition shall avoid misunderstandings e.g. to EN 298.

3.7.24**air proving device**

device intended to cause safety shutdown in the event of abnormal conditions of air admission or of combustion products evacuation

3.7.25**gas/air ratio control**

device that automatically adapts the combustion air rate to the gas rate or vice versa

3.7.26**nominal voltage**

voltage or range of voltages stated in the technical specifications/instructions at which the mCHP appliance can operate normally

3.7.27**nominal frequency**

frequency stated in the technical specifications/instructions at which the mCHP appliance can operate normally

3.7.28**nominal working combustion products temperature**

maximum temperature of the combustion products of normal functioning, at the exit of the mCHP appliance where it is intended to be connected to a duct, flue or chimney

Note 1 to entry: Normal functioning is considered to reflect the situation of running the mCHP appliance at heating water inlet/outlet temperatures of 70 °C/90 °C, or just at the point that the control thermostat is switching when set to the highest possible value.

3.7.29**overheat combustion products temperature**

maximum temperature of the combustion products in case of overheat, at the exit of the mCHP appliance where it is intended to be connected to a duct, flue or chimney

3.7.30**condensing operation mode of the flue system**

operation mode where, under normal operation conditions, condensate is produced in the combustion products

3.7.31**summer operating mode**

operating mode in which the combination mCHP appliance only provides heating of the domestic water

3.7.32**nominal domestic hot water heat input (Q_{nw})**

value of the heat input in the domestic hot water mode indicated in the appliance instructions

Symbol: Q_{nw}

Unit: kilowatt (kW)

3.7.33**maximum water service pressure**

maximum pressure permitted in the domestic water circuit of combinations mCHP appliance, as stated in the appliance instructions

3.8**country of destination****3.8.1****direct country of destination**

country for which the mCHP appliance has been certified, and which is specified in the technical specifications/instructions as the intended country of destination

Note 1 to entry: At the time of putting the mCHP appliance on the market and/or of installation, the mCHP appliance shall be capable of operating, without adjustment or modification, with one of the gases distributed in the country concerned, at the appropriate supply pressure. More than one country can be specified if the mCHP appliance, in its current state of adjustment, can be used in each of these countries.

3.8.2**indirect country of destination**

country for which the mCHP appliance has been certified, but for which, in its present state of adjustment, it is not suitable

Note 1 to entry Subsequent modification or adjustment is essential in order that it can be used safely and correctly in this country.

3.9**internal cooling circuit**

loop in which a fluid circulates intended to maintain the various elements of the mCHP appliance at their operating temperature

3.10**domestic hot water****DHW**

water delivered by the mCHP appliance, raised to a certain temperature in order to use it for domestic needs, e.g. kitchen, bathroom, etc.

3.11**system for permanent operation**

system that is designed to remain in the running condition for longer than 24 h without interruption

3.12**system for non-permanent operation**

system that is designed to remain in the running condition for less than 24 h

3.13 Installation**3.13.1****mCHP appliances intended to be installed in a partially protected place**

mCHP appliances intended to be installed in the open air, not exposed to the direct action and infiltration of rain, snow or hail

Note 1 to entry: If an appliance is sold with a casing to provide protection, this casing is an integral part of the appliance.

3.13.2**minimum declared installation temperature for mCHP appliances in partially protected places**

minimum ambient temperature as stated in the technical specifications/instructions, at which the mCHP appliances is designed to operate and at which all materials and devices shall operate properly and safely

3.13.3**maximum declared installation temperature for mCHP appliances in partially protected places**

maximum ambient temperature as stated in the technical specifications/instructions, at which the mCHP appliances is designed to operate and at which all materials and devices shall operate properly and safely

3.14**competent person**

person who has gained the ability by appropriate training, knowledge and experience to supervise or carry out the work being undertaken in a safe and proper manner

** 3.15****annual energy consumption** **Q_{HE}**

net annual energy consumption of a heater required for space heating to meet the reference annual heating demand for a designated heating season, expressed in GJ in terms of GCV 

4 Classification**4.1 Gases/Categories**

Gases are classified into families, groups and ranges in accordance with EN 437.

mCHP appliances are classified into categories in accordance with EN 437.

NOTE It could be possible that additional test gases have to be taken into account. Unless there is no decision made, the currently existing limit gases are state of the art.

4.2 Mode of air supply and evacuation of combustion products**4.2.1 General**

NOTE 1 The classification used in this European Standard is based on the classification of CEN/TR 1749.

Type B mCHP appliance is an appliance intended to be connected to a flue system evacuating the combustion products to the outside the room containing the appliance, with the combustion air being drawn directly from the room where the appliance is installed.

Type C mCHP appliance is an appliance in which the combustion circuit is sealed with respect to the room in which the appliance is installed.

The air supply and the combustion products evacuation ducts and the terminal or the fitting piece which is used to connect the mCHP appliance to a chimney or duct system are part of the mCHP appliance unless otherwise stated in the technical specifications/instructions. They admit fresh air from inside or outside the inhabitable part of the building to the system and they discharge the products of combustion to the outside.

mCHP appliances are classified into several types according to the mode of evacuation of the combustion products and supply of the combustion air (see examples attached in the informative Annex B).

The types are defined by two subscripts:

- the first subscript number is based upon the possible installation of the mCHP appliance with respect to the mode of air supply and evacuation of the combustion products (see 4.2.2);
- the second subscript number is based upon the presence and the positioning of one or more integral fan(s) in the mCHP appliance (see 4.2.3).

NOTE 2 A combination of suitable type B and type C appliances may be permitted if they are separated to the different functions of a fuel cell mCHP appliance as e.g. reformer or stack.

4.2.2 Type of installation of a mCHP appliance (See informative Annex B)

4.2.2.1 Type B₂

This is a type B mCHP appliance without a draught diverter.

4.2.2.2 Type B₃

This is a type B mCHP appliance without a draught diverter. The appliance is connected via its ducts possibly by means of a fitting piece to a duct system or to an individual or common chimney for the discharge of the combustion products. The supply of the combustion air is drawn directly from the room where the appliance is installed. The duct for the combustion products is completely integrated in the combustion air duct.

4.2.2.3 Type B₅

This is a type B mCHP appliance, without a draught diverter, that is designed for connection via its flue ducts to its flue terminal.

4.2.2.4 Type C₁

This is a type C mCHP appliance which is connected via its ducts to a horizontally installed terminal at the wall or on the roof. The orifices of the ducts are either concentric or close enough to come under similar wind conditions.

4.2.2.5 Type C₃

This is a type C mCHP appliance which is connected via its ducts to a vertically installed terminal. The orifices of the ducts are either concentric or close enough to come under similar wind conditions.

4.2.2.6 Type C₄

This is a type C mCHP appliance which is connected via its ducts possibly by means of a fitting piece to a common duct system consisting of a duct for the supply of the combustion air and a duct for the discharge of the combustion products.

The orifices of the ducts are either concentric or close enough to come under similar wind conditions.

4.2.2.7 Type C₅

This is a type C mCHP appliance which is connected via its separate ducts to two terminals that may terminate in zones of different pressure.

4.2.2.8 Type C₆

This is a type C mCHP appliance which is intended to be connected to a separately approved and marketed system for the supply of combustion air and discharge of the combustion products.

4.2.2.9 Type C₈

This is a type C mCHP appliance which is connected via its ducts possibly by means of a fitting piece to an air supply terminal and fitted to an individual or common chimney.

4.2.2.10 Type C₉

This is a type C mCHP appliance similar to a type C₃ appliance in that it is designed for use with a vertical terminal, which at the same time admits fresh air to the burner and discharges the products of combustion to the outside through orifices that are either concentric or close enough to come under similar wind conditions.

However, the only difference for this appliance type is that the air inlet duct, or part of it, is an existing vertical duct within the building e.g. a converted chimney.

4.2.3 Presence and position of a fan

A type B or type C mCHP appliance that incorporates at least one fan downstream of the combustion chamber/heat exchanger is identified by the second subscript number “2”.

A type B or type C mCHP appliance that incorporates at least one fan upstream of the combustion chamber/heat exchanger or, in the case of an internal combustion engine type mCHP appliance, a comparable suction / pressure function is identified by the second subscript number “3”.

4.3 Maximum water side operating pressure

mCHP appliance classification according to the maximum water side operating pressure (PMS):

- pressure class 1: PMS = 1 bar
- pressure class 2: PMS = 3 bar
- pressure class 3: 3 bar < PMS < 6 bar

NOTE Internal cooling circuits in mCHP appliances are not considered under this classification, e.g. internal cooling circuits for heat exchange in fuel cell mCHP appliances.

4.4 Expansion system

mCHP appliances are classified according to the expansion system used for the central heating circuit:

- open vented system: intended exclusively for a central heating system with an open expansion vessel;
- sealed system: suitable for a central heating system with a sealed expansion vessel.

5 Constructional requirements

5.1 General construction

Except where otherwise stated, the constructional requirements of the mCHP appliance are verified by inspection and the technical documentation. Appropriate materials, components and control devices shall be used.

Component parts of covers, operating controls and safety devices and electrical accessories shall be arranged in such a way that their environmental temperatures at the location of the components in the mCHP appliance under steady state conditions do not exceed those specified for the component' part standard or in the components specifications if these temperatures are exceeding those given in the component part standard.

The use of asbestos-containing materials is forbidden.

Hard solder containing cadmium in its formulation shall not be used in the construction of the appliance.

For mCHP appliances intended to be installed in a partially protected place, all materials employed in the construction, including seals, gaskets and sealing pastes, if any, shall function properly in the environmental conditions under which they are expected to operate.

For mCHP appliances installed in partially protected places it shall be declared in the technical instructions for the installer the minimum and maximum ambient temperatures at which the appliance is designed to operate.

A1 The design and the construction shall be based on a risk assessment to ensure that

- a) all reasonably foreseeable hazards, hazardous situations and events throughout the anticipated mCHP appliance's lifetime, have been identified;
- b) the risk for each of these hazards has been estimated from the combination of probability of occurrence of the hazard and of its foreseeable severity;
- c) the two factors which determine each one of the estimated risks (probability and severity) have been eliminated or reduced to a level not exceeding the acceptable risk level as far as practically possible through
 - 1) inherently safe design of the construction and its methods, or
 - 2) passive control of energy releases without endangering the surrounding environment (e.g. burst disks, release valves, thermal cut-off devices) or by safety related control functions, and
 - 3) for residual risks which could not have been reduced by the measures according to 1) and 2) the provision of labels, warnings, or requirements of special training, considering that such measures need to be understood by the persons which are in the area of the hazards.

If not stated elsewhere in this standard safety related measures are explicitly given in the measures required for functional safety and the allocation of the class of control function shall be determined and designed in accordance with

- EN 60335-2-102 in conjunction with EN 60335-1, on an appliance level, and
- EN 60730-1 on a control level.

NOTE The following hazards can be addressed:

- mechanical hazards: sharp surfaces, tripping hazards, moving masses and instability, strength of materials and liquids or gases under pressure;
- electrical hazards: contact of persons with live parts, short-circuits, high voltage;

- thermal hazards: hot surfaces, release of high temperature liquids or gases, thermal fatigue;
- fire and explosion hazards: flammable gases or liquids, potential for explosive mixtures during normal or abnormal operating conditions, potential for explosive mixtures during fault conditions;
- malfunction hazards: unsafe operation of installation related equipment due to failures of software, control circuit or protective/safety components or incorrect manufacturing or misoperation;
- material and substance hazards: material deterioration, corrosion, embrittlement, toxic releases, choking hazards (e.g. by replacing oxygen by inert purge gases);
- waste disposal hazards: disposal of toxic materials, recycling, disposal of flammable liquids or gases;
- environmental hazards: unsafe operation in hot/cold environments, rain, flooding, wind, earthquake, external fire, smoke. 

The following components of a fuel cell or internal combustion engine mCHP appliance shall be housed in a unit to prevent unintended discharge of supply gas, process gas, or flue gas in the installation room:

- gas carrying circuit;
- fuel cell stack or internal combustion engine as appropriate for the type of mCHP appliance;
- internal flue system;
- fuel gas processing (if existing);
- internal cooling circuits (if existing).

An alternative of housing the above mentioned components is to comply with EN 62282-3-100:2012, 4.6.1.

The mCHP appliance shall be resistant to deformation and shall be such that

- the materials shall withstand the thermal, mechanical and chemical stresses arising during normal operation,
- the primary heat & power generator cannot become heated to create a hazard,
- in the event of engine malfunction or appliance ageing, there shall be no possible direct leakage path between the chambers containing working fluid and chambers containing the fluid used in the central heating or DHW production circuits,

NOTE Examples of unacceptable paths are those sealed with screw joints, o-ring joints, flange joints.

- for ICE and Stirling Engine pipes and other conduits for gas or gas/air mixtures connecting those parts of the appliance which are to be fixed to those parts of the appliance subject to mechanical vibration shall be demonstrably fit for purpose especially with regard to temperature, pressure, general degradation and level of vibration. Such pipes may be semi-rigid or connect via suitable mechanically flexible connectors. Entirely rigid connections shall not be used.

5.2 Use and servicing

The appliance shall be so designed that the user has access to and can operate all control knobs and buttons necessary for normal use of the mCHP appliance without having to remove any part of the case.

However, part of the case may be removed provided that this part can be handled safely by the user, that this part can be removed without the use of tools and that incorrect replacement is difficult (e.g. by the provision of stops).

All markings intended for the user shall be easily visible and shall be made in a clear and indelible manner.

Parts which are required to be inspected or removed for servicing shall be easily accessible, possibly after removal of the case, in accordance with the instructions for maintenance/servicing.

Removable parts shall be designed or marked so that they are difficult to re-assemble incorrectly.

If the appliance instructions require parts of the mCHP appliance to be cleaned it shall be possible to do this easily and/or remove them easily for servicing with the use of commercially available tools. This shall not involve disconnection of the mCHP appliance from the gas or water pipes.

For mCHP appliances connected to an air supply system and/or combustion products evacuation system that forms part of the construction of the building, it shall be possible to carry out servicing of the mCHP appliance without dismantling the permanent connections to the duct.

The soundness of the combustion circuit shall be maintained after reassembly and, if necessary, in accordance with the appliance instructions, after replacement of the seal(s) following cleaning and servicing operations.

5.3 Connections to the gas and water pipes

5.3.1 General

The mCHP appliance connections shall be easily accessible. They shall be clearly identified in the installation instructions and possibly on the mCHP appliance.

The clearance around the connections, after removing the case if necessary, shall be adequate to allow easy use of the tools required to make the connection.

It shall be possible to make all the connections without special tools.

5.3.2 Connection to the gas pipe

It shall be possible to connect the mCHP appliance by a rigid or a flexible metallic pipe to the gas supply pipe.

If the mCHP appliance has a threaded connection, this thread shall comply with EN ISO 228-1 or ISO 7-1. In the first case (EN ISO 228-1), the end of the mCHP appliance inlet connection shall offer a sufficiently flat annular surface to allow the use of a sealing washer.

 If flanges are used, they shall comply with the relevant requirements of EN 1092-1, EN 1092-2, EN 1092-3, or EN 1092-4, concerning the relevant flange types and their facings, dimensions, tolerances, threading, bolt sizes, flange jointing face surface finish, materials, pressure and temperature ratings and approximate flange masses. 

The different national gas connection conditions are given in Table A.1.

5.3.3 Connection to the central heating or domestic water pipes

Threaded connections shall comply with EN ISO 228-1, EN 10226-1 or EN 10226-2.

If copper connections are used, the connecting end of the tube shall comply with EN 1057.

If other than metallic materials are used, the appropriate justification for their suitability of use shall be given in the design documentation.

In accordance with the appliance instructions, the domestic water circuit shall be able to be drained, without the discharge of water compromising electrical safety.

5.4 Soundness

5.4.1 Soundness of the gas carrying circuit

The gas circuit shall consist of metallic parts.

Where the internal pressure for the gas carrying circuit is at or above ambient pressure during conditions when supplied gas or process gas is carried by that circuit, the following apply:

- Holes for screws, studs, etc., intended for the assembly of parts shall not open into gas paths. The wall thickness between drillings and gas paths shall be at least 1 mm. This does not apply to orifices used for measurement purposes.
- The soundness of parts and assemblies making up the gas carrying circuit and likely to be dismantled during a normal routine servicing operation in situ or during gas conversion shall be achieved by means of mechanical joints, for example metal to metal joints, gaskets or toroidal seals. These sealing materials shall remain effective under normal conditions of mCHP appliance use. The use of sealing materials such as tape, paste, glue or liquid is not acceptable, although this type of sealing material may be used for permanent assemblies.
- Where parts of the gas carrying circuit are assembled without threads, soundness of the assembly shall not be achieved by means of soft solder.

If a control function ensures that the gas carrying circuits operates below ambient pressure, and the above requirements have not been taken into account or the tests according to 6.2.1 have not been performed, the

- mechanical/ pneumatic control shall comply with EN 88-1 or the relevant clauses of EN 13611, or
- the control function shall be a class C control function according to EN 13611.

5.4.2 Soundness of the combustion circuit

The combustion circuit shall be constructed so as to prevent any leakage of combustion products.

Any means used to achieve soundness of the combustion circuit shall be such that it remains effective under normal conditions of use and servicing.

Parts, which have to be removed during routine service and affect the soundness of the mCHP appliance and/or its ducts, shall be sealed by mechanical means, excluding pastes, liquids and tapes. The need for replacement of the seal(s), following a cleaning or servicing operation in accordance with the instructions for maintenance, is permitted.

Where the mCHP appliance case forms part of the combustion circuit and it can be removed without the use of tools, either the appliance shall not operate, or there shall be no leakage of combustion products into the room where the mCHP appliance is installed when the case is replaced incorrectly.

However, parts of the assembly not intended to be dismantled for maintenance may be joined in such a way, that permanent soundness is ensured during continuous service under normal conditions of use.

The ducts, bends, if any, and the terminal or fitting piece shall fit together correctly and shall form a stable assembly. Parts intended to be dismantled for periodic servicing shall be designed and arranged so that soundness is ensured after reassembly.

Any fitting piece shall allow a sound connection to be made to the system intended for the evacuation of combustion products and supply of air.

For ICE the internal leakage in the combustion chamber to the crank case shall be re-circulated to the air-inlet of the engine.

For ICE the external leakage of the engine shall

- a) be ignited immediately with the mixture designed to be burned in the engine, or
- b) be contained by the entire engine being surrounded by combustion air or cooling water, or
- c) lead to non-operation of the engine under such leakage conditions, or
- d) meet the leakage requirements of 6.2.2.

5.4.3 Soundness of lubricating oil circuit

In the case of leakage from the lubricating-oil system or as a result of a fault or crack in parts of the appliance where lubricating-oil is designed to be present, there shall be no escape of oil into the room where the mCHP appliance is installed.

5.5 Supply of air and evacuation of combustion products

5.5.1 General

All mCHP appliances shall be designed so that there is an adequate supply of air during ignition and over the whole range of possible heat inputs stated in the technical specifications/instructions. A gas/air ratio control is permitted.

All fuel cell mCHP appliances shall be designed so that there is an adequate supply of air during all operation conditions of the fuel cell stack and over the whole range of possible heat inputs stated in the technical specifications/instructions.

Fan assisted mCHP appliances may be fitted with a means of adjustment in the combustion circuit intended to adapt the mCHP appliance to the pressure losses in the installed ducts, either by restrictors or by setting the means of adjustment to predetermined positions in accordance with detailed instructions for installation.

5.5.2 Air supply and combustion products evacuation ducts

The assembly of the various parts during installation shall be such that no work is necessary other than adjusting the length of the air supply and combustion products evacuation ducts (possibly by cutting them). Such adaptation shall not impair the correct operation of the appliance.

It shall be possible to connect the mCHP appliance, the air supply and combustion products evacuation ducts and the terminal or fitting piece in accordance with the appliance installations instructions using ordinary tools if necessary.

Terminal guard if it exists and fitting pieces have to be installed in accordance with the instructions for installation.

The terminal outlets from separate ducts for the supply of combustion air and the evacuation of combustion products

- shall fit inside a square with an edge length of 50 cm for type C₁ and C₃ appliances,
- may terminate in zones of different pressure for type C₅ appliances, but not on opposite walls of the building.

5.5.3 Terminal

Terminals on appliances without a fan should prevent the intrusion of external objects by having no opening in the external surfaces of the terminal which shall permit the entry of a 16 mm diameter ball when applied with a force of 5 N.

Any horizontal terminal for non-condensing mCHP appliances shall be designed in such a way that condensate is discharged away from the wall.

Any horizontal terminal for condensing mCHP appliances shall be designed in such a way that condensate is directed towards the appliance.

5.5.4 Terminal guard

If the installation instructions require a protective guard for the terminal for use when the outlets for evacuation of the combustion products open on to a walkway, the dimensions of the terminal guard shall be such that the distance between any part of the guard and the terminal, except the wall plate, exceeds 50 mm. The guard shall not have any sharp edges likely to cause injury.

5.5.5 Fitting piece

For appliances of the types C₄ and C₈, the fitting piece shall be designed so that it is possible to obtain the distances specified in the instruction for installation for the projection of the ends of the combustion air supply and combustion products discharge ducts into the common duct, whatever the total thickness (flue and cladding) of the common duct.

5.6 Requirements for a fan incorporated in a mCHP appliance

Direct access to the rotating parts of a fan or a turbocharger shall be prevented. The parts of a fan in contact with combustion products shall be effectively protected against corrosion unless they are of corrosion resistant material; furthermore they shall withstand the temperature of the combustion products.

5.7 Gas/air ratio controls

Gas/air ratio controls shall be designed and constructed so that reasonably foreseeable damage does not give rise to a change capable of affecting safety.

Pneumatic gas/air ratio controls shall comply with the relevant requirements of EN 88-1.

Electronic gas/air ratio controls shall comply with the relevant requirements of EN 12067-2.

Control tubes may be made of metal with suitable mechanical connections or of other materials with at least equivalent properties and in this case are considered immune to breakage, accidental disconnection and leakage after initial soundness checks.

Control tubes for air or combustion products shall have a minimum cross-sectional area of 12 mm² with a minimum internal dimension of 1 mm. They shall be located and fixed so that any retention of condensate is avoided and positioned such that creasing, leakage or breakage is prevented. Where more than one control tube is used the relevant connection position for each shall be obvious.

If the installation instructions state (see 9.2.1.3) that the gas/air ratio control settings are not intended to be adjustable by a gas operative during installation, appliance service or when the gas valve is replaced then the appliance shall incorporate additional provisions to discourage unauthorised interference with the gas/air ratio control settings.

The following examples are considered to be suitable additional provisions:

- a) Physical removal of the adjustment screws (or other method of rendering these inoperative);
- b) Physically preventing access to the adjustment screws (e.g. filling access holes);

- c) Addition of a suitably worded warning label affixed to the gas valve and/or in close proximity to the adjuster screws. This label shall be clearly visible to any gas operative whilst gaining access to the adjuster screws and provision shall be made to indicate if the valve setting has been changed.

NOTE 1 Gas/air ratio controls typically have two adjustments (“throttle” and “offset”) and the requirements of this clause apply to both.

NOTE 2 An example of a suitable provision is to use a paint spot on the adjusting device.

If the appliance installation instructions indicate that the valve can be adjusted, by a suitably qualified gas operative using appropriate instruments, a provision shall be made to indicate that the valve setting has been changed.

NOTE 3 An example of a suitable provision is to use a paint spot on the adjusting device.

The appliance instructions shall include instructions on how the settings shall be checked if, at the time of installation or service, there is an indication that the gas/air ratio control settings have been altered. The appliance installation instructions shall indicate the action to be taken if the settings are found to be incorrect.

If the appliance installation instructions allow the gas/air ratio controls to be adjusted then the method for adjustment shall be described.

5.8 Air proving

mCHP appliance with fans¹⁾ shall be fitted with a system for air proving.

Except for mCHP appliances with gas/air ratio controls, before each fan start it shall be checked that there is no simulation of air flow in the absence of air flow.

The system for supervision of the combustion air rate or combustion products rate shall be activated directly by the flow of combustion air or combustion products. This is also valid for mCHP appliances with more than one fan speed in which the flows associated with each fan speed are monitored.

The supply of combustion air shall be checked by one of the following methods:

- a) gas/air ratio control²⁾;
- b) continuous supervision of the combustion air rate or combustion products rate;
- c) start-up supervision of the combustion air rate or combustion products rate provided that:
 - the combustion products circuit is completely surrounded by the air supply circuit, or the leakage rate of the combustion products circuit meets the requirements of 6.2.2.2.2 and
 - there is a shutdown at least every 24 h³⁾ and
 - there is an indirect system for air proving (e.g. fan speed supervision) during operation.

¹⁾ In an ICE, a turbo charger is considered to be comparable to a combustion air fan. Adequate measures to ensure at least the same level of safety (according 5.10) shall be used.

²⁾ The Gas/Air ratio control according to EN 12067-2:2004, 7.1 includes the function that the air flow is ensured (signal directly activated by the flow) and if not a safety reaction is initiated.

³⁾ Some appliances will be used in a way that it is very likely that they will shutdown at least once per 24 h without having a specific function to ensure this.

Only for mCHP appliances where the combustion products circuit is completely surrounded by the air supply circuit or for separate ducts when the leakage rates of the combustion products evacuation ducts meets the requirements of 6.2.2.2.2, the following two indirect supervision methods are also allowed:

- d) indirect supervision (e.g. fan speed supervision) when there is an air proving device which proves the supply of combustion air at least once at each start-up;
- e) supervision of the minimum and maximum air or combustion products rates with two rate supervision devices.

5.9 Checking the state of operation

The design of the appliance shall be such that the installer can determine, by visual means, the operational phase of the mCHP appliance including whether it is in its “starting” or “stopping” phase.

NOTE This may be by observing the ignition and operation of the burner(s) and also the length of the flame(s) of the ignition burner, if any OR by an indirect means of indication (e.g. an indicator light). Indirect means are dependent on the specific solution of the manufacturer.

If used, mirrors, sight glasses, etc., shall continue to retain their optical properties.

The indication of flame presence shall not be used to indicate any fault, except for a fault in the operation of the means of checking the flame itself, which shall result in an indication that there is no flame.

It shall be possible for the user, perhaps after opening a door, to check at any time that the mCHP appliance is operating, either by visual observation of the flame or by some other indirect means.

If the indirect signal of flame presence is only available on a remote control, this remote control shall be supplied and tested with the mCHP appliance.

5.10 Operational safety in the event of failure of the energy supply for the control systems

A1 If the mCHP appliance uses an energy supply for the control systems, the control system shall tolerate failure of the auxiliary energy or following its restoration without occurring hazardous situations. **A1**

5.11 Drainage

If it is not possible to drain the appliance by means of its water connections, it shall carry a device that enables it to be drained and can be operated by means of a tool such as a spanner or screwdriver. Suitable directions for drainage, without the discharge of water compromising electrical safety, shall be included in the instructions.

5.12 Conversion to different gases

The following actions are allowed in order to convert from a gas of one family or group to a gas of another family or group:

- electronic adjustment to ensure correct maximum heat input and/or combustion quality;
- adjustment of the gas rate of the main burner(s), internal combustion engine and ignition burner;
- change of restrictor or injector;
- change of ignition burner or its components;
- change of gas rate modulation system;
- adjustment of the ignition point;
- putting out of service and sealing an adjuster or control device (e.g. gas rate adjuster, pressure regulator);

- Ⓐ₁ – changes of configuration parameters by data exchange (for requirements see EN 13611); Ⓐ₁
 - by use of combustion control system methods taking the requirements of EN 12067-2 into account.

For each of the operations mentioned above the appliance shall be tested with each of the gases. These operations shall be possible without having to interfere with the connections of the mCHP appliance to its connecting pipe-work, i.e. gas supply, water supply and air inlet and combustion product evacuation ducts.

5.13 Materials and thickness

5.13.1 General

The quality and thickness of the materials used in the construction of the mCHP appliances, their combustion product evacuation ducts, fitting pieces and terminals and the method of assembling the various parts, shall be such that the constructional and operational characteristics are not significantly altered during a reasonable life and under normal conditions of installation and use.

All parts of the mCHP appliance shall withstand the mechanical, chemical and thermal conditions to which they may be subjected when the appliance is used normally.

Materials downstream of the heat exchanger shall be corrosion-resistant or be effectively protected against corrosion.

The materials of the parts containing domestic water shall not affect the quality of the domestic water in respect of either health or taste.

The whole of the domestic hot water circuit shall be made up of corrosion resistant materials or shall be protected against corrosion.

5.13.2 Materials and thicknesses of walls or tubes under water pressure of pressure class 3

5.13.2.1 General

The characteristics of the materials and the thicknesses of walls under pressure shall comply with the requirements of 5.13.2.2, 5.13.2.3 and 5.13.2.4. If other materials and/or other thicknesses are used, these shall have an equivalent level of fitness for purpose.

5.13.2.2 Materials

Materials for parts under pressure shall be appropriate for their duty and envisaged use.

The following materials satisfy these criteria:

- steels that have the properties and chemical composition detailed in Table 1;
- cast irons that have the mechanical properties detailed in Table 2;
- the non-ferrous materials detailed in Table 3 and Table 4.

5.13.2.3 Thickness

The minimum wall thicknesses of parts under water pressure are given in Table 5 and Table 6.

For rolled steel the tolerances are given in EN 10029.

The thicknesses of cast walls given in the production drawings shall not be less than the nominal minimum thicknesses given in Table 6 for parts of cast iron or of cast materials which are subjected to pressure. The actual minimum thickness of the appliance sections and of parts subjected to pressure shall be greater than 0,8 times those given in the drawings.

5.13.2.4 Welded seams and welding fillers

Materials shall be suitable for welding. The materials given in Table 1 may be used and do not require additional heat treatment for welding.

Welded seams shall show no cracks or bonding faults and butt welded seams shall be faultlessly welded over the whole cross-section.

Single-sided fillet welds and half Y-welds without full penetration into the base metal shall not be subjected to bending stresses. Flue pipes, set-through stays and similar components need not to be welded from both sides. Double fillet welds are permissible if sufficiently cooled.

Projections into the flue ways in areas of high thermal stresses shall be avoided.

Corner welds, edge welds and similar welds which are subject to considerable bending stresses under unfavourable manufacturing or operating conditions are to be avoided.

For welded-in longitudinal stays, stay tubes or stay bolts, the shearing cross-section of the fillet weld shall be at least 1,25 times the required cross-section of the bolt or stay tube.

Details of the welds mentioned are given in Table 7. Welding fillers shall permit a joint appropriate to the base material to be made.

^[A1] The terms given in Table 7 are in accordance with EN ISO 2553; the reference numbers of welding processes are respectively in accordance with ISO 857-2 and EN ISO 4063. ^[A1]

Table 1 – Mechanical properties and chemical compositions of carbon and stainless steels

Mechanical properties						Chemical composition by mass									
						%									
Materials	Steel type	Tensile strength R_m N/mm ²	Yield point $R_{0.2}$ N/mm ²	Breaking elongation A_{long} at $L_0 = 5 d_0$ %	Breaking elongation A_{transv} at $L_0 = 5 d_0$ %	C	P	S	Si	Mn	Cr	Mo	Ni	Ti	Nb/Ta
Pipes, sheets	carbon	≤ 520	≤ 0,7 ^a	≥ 20	—	≤ 0,25	≤ 0,05	≤ 0,05	—	—	—	—	—	—	—
	ferritic	≤ 600	≥ 250	≥ 20	≥ 15	≤ 0,08	≤ 0,045	≤ 0,030	≤ 1,0	≤ 1,0	15,5 to 18	≤ 1,5	—	≤ 7 × %C	≤ 12 × %C
	austenitic	≤ 800	≥ 180	≥ 30	≥ 30	≤ 0,08	≤ 0,045	≤ 0,030	≤ 1,0	≤ 2,0	16,5 to 20	2,0 to 3,0	9 to 15	≤ 5 × %C	≤ 8 × %C

^a Ratio yield point–tensile strength.
An adequate high temperature yield point for the highest possible temperature of the steel shall be guaranteed.

Table 2 – Minimum requirements for cast iron

Flake graphite cast iron (EN 1561):	
– Tensile strength R_m	≥ 150 N/mm ²
– Brinell hardness	160 HB to 220 HB 2,5/187,5
Spheroidal graphite cast iron (annealed ferritic):	
– Tensile strength R_m	≥ 400 N/mm ²
– Notch impact strength	≥ 23 J/cm ²

Table 3 – Parts in aluminium and aluminium alloys

	Tensile strength R_m N/mm ²	Temperature range °C
Al 99,5	≥ 75	up to 300
Al Mg2 Mn 0,8	≥ 275	up to 250

Table 4 – Parts in copper or copper alloys

	Tensile strength R_m N/mm ²	Temperature range °C
SF – Cu	≥ 200	up to 250
Cu Ni 30 Fe	≥ 310	up to 350

Table 5 – Minimum thicknesses for rolled parts

Carbon steels; aluminium			Protected steels; stainless steels; copper		
a ^a mm	b ^b mm	c ^c mm	a ^a mm	b ^b mm	c ^c mm
4	3	2,9	2	2	1
^a Column a: for walls of combustion chambers exposed to water and fire, and for horizontal walls of convection heating surfaces. ^b Column b: for walls exposed only to water and for rigid shapes, for example convection heating surfaces outside the combustion chamber. ^c Column c: tubes of convection heat exchangers.					

Table 6 – Nominal minimum thicknesses of mCHP appliance sections

Nominal heat input Q_n kW	Flake graphite cast iron aluminium mm	Spheroidal graphite annealed ferritic cast iron, copper mm
≤ 35	3,5	3,0
> 35	4,0	3,5

Table 7 – Weld joints and welding processes

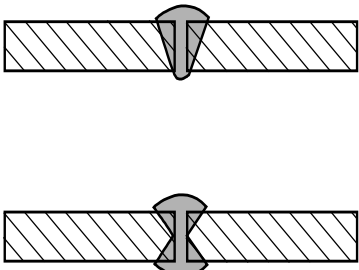
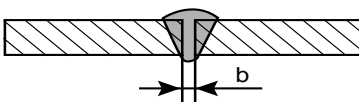
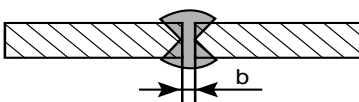
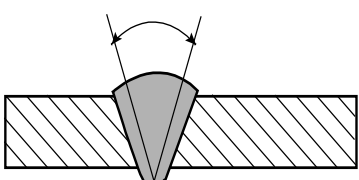
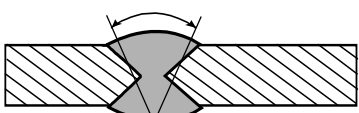
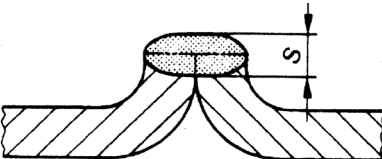
No.	Weld joint type	Material thickness t mm	Welding process ^a	Remarks
1.1	Square butt weld 	≤ 6 (8)	135 12 131 (111)	Permissible up to $t = 8$ mm on use of deep penetration electrodes or welding on both sides
1.2	Square butt weld 	≥ 6 up to 12	12	Root gap $b = 2$ mm to 4 mm with stiffener, powder holder necessary
1.3	Square butt weld (double) 	> 8 up to 12	135 12 (111)	Root gap $b = 2$ mm to 4 mm Deep penetration electrodes shall be used for manual electro welding.
1.4	Single-V butt weld 	up to 12	(111)	Seam preparation V-seam 60°
1.5	Single-V butt weld 	up to 12	135 12	Seam preparation V-seam 30° to 50° depending on thickness of material
1.6	Double-V butt weld 	greater than 12	135 12	Seam preparation double V-seam 30° to 50° depending on material thickness
1.7	Butt weld between plates with raised edges 	≤ 6	135 141 131 (111)	Only permissible in exceptional cases for parts welded in. Moreover, the welds have to be kept largely free from bending stresses. Not suitable for directly fired wall parts $s = 0,8 t$

Table 7 – Weld joints and welding processes (continued)

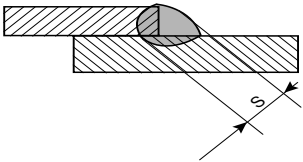
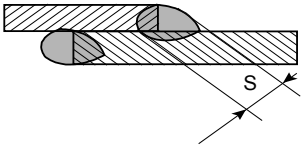
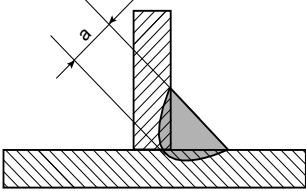
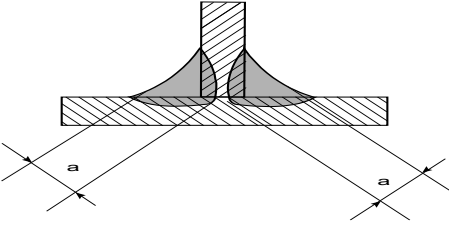
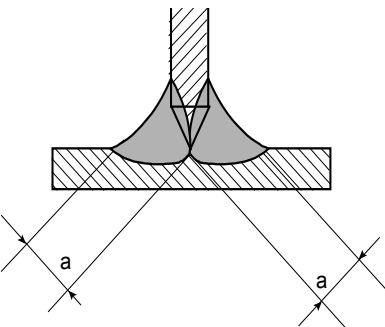
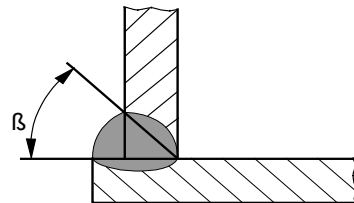
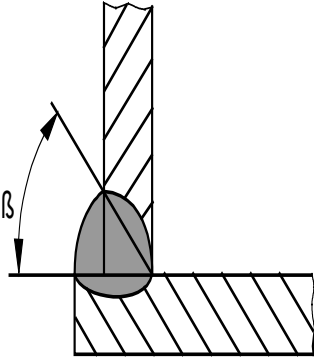
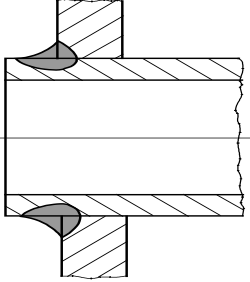
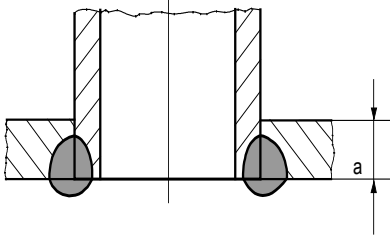
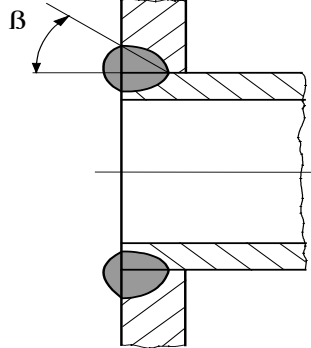
No.	Weld joint type	Material thickness t mm	Welding process ^a	Remarks
1.8	Overlap welding 	≥ 6	135 12	Welds of this type are to be kept largely free from bending stresses. Not suitable for directly fired wall parts $s = t$
1.9	Overlap welding (continued) 	≤ 6	135 12 (111)	Not suitable for directly fired wall parts $s = t$
2.1	Fillet weld 	≤ 6	135 12 (111)	Welds of this type are to be kept largely free from bending stresses. $a = t$
2.2	Double-fillet weld 	≤ 12 > 12	135 12 (111) 135 12 (111)	$a = t$ $a = 2/3 t$
2.3	Double-bevel butt weld 	≤ 12 > 12	135 12 (111) 135 12 (111)	$a = t$ $a = 2/3 t$
2.4	Single-bevel butt weld 	≤ 12	135 12 (111)	for (111) $\beta = 60^\circ$

Table 7 – Weld joints and welding processes *(continued)*

No.	Weld joint type	Material thickness t mm	Welding process ^a	Remarks
		> 12	135 12	for 135, 12 $\beta = 45^\circ$ to 50°
2.5	Single-bevel butt weld 	≤ 12	135 12 (111)	for (111) $\beta = 60^\circ$ for 135, 12 $\beta = 45^\circ$ to 50°
2.6		≤ 12	135 (111)	Tube ends shall not project beyond fillet weld if it is subjected to heat radiation.
2.7		≤ 6	135 (111)	Welding in of tube under high thermal stress $a \geq t$
2.8			135 (111)	Welding in of tube under high thermal stress For (111) $\beta = 60^\circ$ For 135 $\beta = 45^\circ$ to 50°

^a Reference numbers of welding processes in accordance with ISO 857-1, ISO 857-2 or EN ISO 4063:	
Reference number	Process
12	Submerged arc welding
111	Metal-arc welding with covered electrode
131	Metal-arc inert gas welding; MIG welding
135	Metal-arc-active gas welding; MAG welding
141	Tungsten inert gas arc welding TIG welding

5.13.2.5 Materials and method of construction of components of the domestic water circuit for combination mCHP appliances

Materials shall be appropriate for their use, under intended application and at the maximum water pressure stated in the installation instruction.

The requirements relating to thermal insulation and its use specified in 5.14 only apply to parts of the domestic water circuit likely to come into contact with flames or sited close to the combustion products outlet.

The materials of the parts containing domestic water shall not affect the quality of the domestic water in respect of either health or taste.

The whole of the domestic hot water circuit shall be made up of corrosion resistant materials or shall be protected against corrosion.

5.14 Thermal insulation

The insulation shall withstand the normally expected thermal and mechanical stresses, without deformation and shall retain its insulating properties under the influences of heat and ageing.

The insulation shall be of fire-retardant material Euro-Class B according to EN 13501-1. However, normal-flammability materials Euro-Class D according to EN 13501-1 are permitted provided that

- the insulation is applied to surfaces in contact with water,
- or the temperature of the surface to which it is applied does not exceed 85 °C in normal operation,
- or the insulation is protected by a non-combustible case having an appropriate wall thickness.

If flames can come into contact with the insulation the insulation shall be non-flammable material Euro-Class A1 or A2 according to EN 13501-1.

5.15 Durability against corrosion of metallic combustion product circuits

The durability against corrosion of the combustion product circuit is demonstrated by fulfilling either:

- a) the requirements in Table 8, or
- b) a corrosion test method from normative Annex A of EN 1856-1:2009.

Table 8 – Metallic combustion products circuit material specifications

Material	Symbol	Minimum Nominal Thickness non- condensing^{b)} mm	Minimum nominal Thickness condensing^{b)} mm
EN 573-1 Aluminium designation			
EN AW – 4047A	EN AW Al Si 12 (A), and CU <0,1%, Zn<0,15% (cast aluminium)	0,5	1,5
EN AW – 1200A	EN AW-AL 99,0 (A)	0,5	1,5
EN AW-6060	EN AW-Al MgSi	0,5	1,5
EN 10088-1 Steel number	EN 10088-1 Steel name		
1.4401	X5CrNiMo 17-12-2	0,4	0,4
1.4404 ^{a)}	X2CrNiMo 17-12-2	0,4	0,4
1.4432	X2CrNiMo 17-12-3	0,4	0,4
1.4539	X1NiCrMoCu 25-20-5	0,4	0,4
1.4401	X5CrNiMo 17-12-2	0,11 ^{c)}	0,11 ^{c)}
1.4404 ^{a)}	X2CrNiMo 17-12-2	0,11 ^{c)}	0,11 ^{c)}
1.4432	X2CrNiMo 17-12-3	0,11 ^{c)}	0,11 ^{c)}
1.4539	X1NiCrMoCu 25-20-5	0,11 ^{c)}	0,11 ^{c)}
^{a)} Equivalent for material N° 1.4404 = 1.4571 (symbol X6CrNiMoTi 17-12-2). ^{b)} The condensing column shall be used if, under normal operation conditions, condensate is produced in the combustion products circuit (according to 3.7.30) ^{c)} Flexible liners (when installed in an existing chimney)			

The actual minimum thickness of the materials shall always be greater than 90 % of the minimum nominal thicknesses.

5.16 Requirements for valves as parts of the gas circuit

Safety related automatic shut off valves shall meet the requirements of EN 161, other valves shall meet the applicable requirements of EN 13611.

5.17 Combustion products evacuation duct

5.17.1 Stability under mechanical loading

The duct shall be capable of withstanding horizontal and vertical loads. The following aspects shall be considered:

- compressive strength;
- tensile strength;
- where applicable, resistance to lateral load for a reference wind velocity pressure of 1,5 kN/m².

5.17.2 Stability under exposure to heat

The stability of the walls of the duct shall be ensured during and after exposure to heat occurring under all operating conditions of the mCHP appliance.

5.17.3 Corrosion resistance

The duct shall keep its essential characteristics in the presence of the corrosion load corresponding to all operating conditions of the mCHP appliance.

5.17.4 Resistance to condensate and moisture under normal operating conditions

The duct shall keep its essential characteristics in the presence of condensate and moisture under all operating conditions.

5.18 Additional design requirements

5.18.1 General

The mCHP appliance shall be designed such that when it is installed and used in accordance with the instructions for installation and use, if it is not self-venting, it shall be possible to vent the air from the mCHP appliance waterways.

If condensation is produced, this shall not

- affect the operational safety,
- drop outside the appliance.

This requirement does not apply to the flow of condensate which is produced at the outlet of the combustion products evacuation duct.

Constructional parts accessible during use and servicing, in accordance with the instructions for installation, maintenance and use, shall be free from sharp edges and corners that might cause damage or personal injury during use and servicing.

5.18.2 Materials in contact with condensate

All parts of the heat exchanger(s) and other parts of the mCHP appliance likely to come into contact with condensate shall be constructed of sufficiently corrosion resistant materials or materials protected by suitable coating in order to ensure a reasonable life for a mCHP appliance which is installed, used and maintained in accordance with the instructions for installation, maintenance and use.

5.18.3 Discharge of condensate

Condensate produced during operation of the mCHP appliance, including the condensate formed in the flue and its connecting pipes, shall be removed by means of a discharge pipe (or pipes) or other constructions resulting in safe discharge of condensate. Such condensate discharge system shall be of corrosion-resistant material or covered by a durable protection against corrosion.

Where disposal of condensate from the mCHP appliance is by gravity the internal diameter of the condensate discharge outside connection shall be at least 13 mm. If the mCHP appliance incorporates some form of pump assisted condensate disposal the size of the discharge from the mCHP appliance and connection to any point of gravity discharge shall be specified in the instructions for installation.

The disposal system, forming part of the mCHP appliance supplied with the mCHP appliance, shall be such that:

- it can be easily inspected and cleaned in accordance with the appliance instructions,
- it cannot transmit combustion products into the room where the mCHP appliance is installed, this requirement is satisfied if the disposal system incorporates a water trap.

The water trap shall meet 2 requirements:

- a water trap has a seal of at least 25 mm water column,
- The functional operating of the water trap will be tested under the applicable blockage tests b) of 6.5.5.2 or 6.5.5.3.2. In that condition there shall be no leakage of combustion products into the room where the mCHP appliance is installed.

Surfaces in contact with condensates (except purpose provided drains, water traps and siphons) shall be designed to prevent (unintended) condensate retention.

5.19 Gas carrying circuit

5.19.1 General

Where the internal pressure for the gas carrying circuit is at or above ambient pressure, the following minimum requirements of the mCHP appliance are detailed below:

Screwed fastenings that have to be removed for servicing of the device shall have a metric thread complying with ISO 262, unless a different thread is essential for the correct functioning and adjustment of the device.

Thread-forming screws that form a thread and do not produce swarf may be used. Metric machine screws shall comply with ISO 262.

Self-tapping screws that cut a thread and produce swarf shall not be used for the assembly of gas-carrying parts or of parts that may be removed for servicing.

Breather holes shall be so designed that, if the diaphragm is perforated, the air leakage rate does not exceed 70 dm³/h at the maximum upstream pressure. This requirement is deemed to be satisfied if, for a maximum gas supply pressure of 30 mbar, the diameter of the breather hole does not exceed 0,7 mm.

The use of bellows as the sole sealing element with respect to atmosphere is permitted only if the air leakage rate in the event of fracture does not exceed 70 dm³/h at the maximum upstream pressure.

Breather holes shall be protected against blockage or shall be located so that they cannot be easily blocked. They shall be so arranged that the diaphragm cannot be damaged by a device inserted for cleaning purposes.

Seals for moving parts which pass through the body to atmosphere and the seals for the closure member shall only be made of solid material (e.g. synthetic materials with proper mechanical support and of proper mechanical stability) of a type which does not deform permanently (e.g. no sealing paste).

Manually adjustable packing glands shall not be used for sealing moving parts. An adjustable gland which is adjusted and protected against further adjustment and which need not be readjusted is not considered adjustable.

There shall be no accessible shafts or operating levers that could be interfered with in such a way as to prevent closure of the valves.

A strainer according to EN 13611 shall be positioned near the gas inlet.

The design shall be such that

- unintended flow back of process gas into the combustion product circuit shall be prevented or controlled,
- no unintended excess pressure can arise in the process gas,
- no unintended air can enter the supplied gas and/or the process gas,
- no unintended outflow of process gas or working fluid can occur within the unit or into the atmosphere.

5.19.2 Control devices

Every mCHP appliance shall be provided with at least one device to enable the user to close the gas supply to the burner, ignition burner or internal combustion engine (or similar oxidation devices), and the process circuit, as relevant to the design of the mCHP appliance.

The shut-off shall be effected without delay.

Any control and setting device shall be clearly marked and give appropriate instruction as to prevent any error in handling. No markings are required if incorrect operation is impossible.

If the mCHP appliance has two distinct gas rate controls, one for the burner and one for the ignition burner, the operation of these devices shall be interlocked in such a way that it is impossible for the burner to be supplied before the ignition burner.

If the burner and ignition burner are served by a single tap, the position for ignition of the latter shall have a stop or notch making this position clearly perceptible to the user. It shall be possible to carry out the unlatching operation (if any) with one hand.

If the only gas shut-off device operates by turning, it shall turn off in a clockwise direction as seen by an observer facing the knob.

5.19.3 Composition of the gas circuit

Safety devices which require non-volatile lockout to occur shall give rise to simultaneous signal to close the two valves.

The two valves shall be at least class C

- a) in the case of direct ignition of the main burner and if the order to close in response to a control device is not given simultaneously to the two valves.
- b) under the condition that a possible pressure generated by the running internal combustion engine at the gas valve output is less than 7 mbar above the minimum gas inlet pressure during start-up or shut-down periods where the valve is closed. If this pressure is > 7 mbar, then the class of the shut-off valve (see EN 161) shall be selected considering 30 % reserve margin compared to the pressure generated by the running internal combustion engine.

In response to a control device, if the delay between the signals to close the two valves is not greater than 5 s, the signals are considered to be simultaneous.

The composition of the gas circuit shall be according to Table 9.

Illustrations of the composition of the gas circuit are given in Annex C.