

Chimneys — Design, installation and commissioning of chimneys

Part 1: Chimneys for non-roomsealed heating appliances

ICS 91.060.40

National foreword

This British Standard is the UK implementation of EN 15287-1:2007+A1:2010. It supersedes BS EN 15287-1:2007, which is withdrawn.

This British Standard can be considered complementary to BS 5440-1:2008.

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

The UK participation in its preparation was entrusted by Technical Committee B/506, Chimneys, to Subcommittee B/506/1, Chimneys general requirements.

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

National Annexes NA to NE (informative) identify the provisions currently required to meet the UK devolved administrations Building Regulations for chimneys (see Annex NE, Clause NE.2, for details) and encompass recommendations drawn from the requirements of BS 6461-1:1984 and BS 7566 (all parts). Annexes NA to ND inclusive detail recommendations for the installation of chimneys and flues for domestic appliances burning solid fuel (including wood and peat). Annex NE provides information relevant for chimneys to be used with gas and oil appliances.

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

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 30 September 2008

© The British Standards Institution 2013.
Published by BSI Standards Limited 2013

ISBN 978 0 580 83531 5

Amendments/corrigenda issued since publication

Date	Comments
30 November 2008	Correction of National Foreword, and addition of National Annexes NA to NE
30 June 2012	Implementation of CEN amendment A1:2010
31 July 2013	National Annex NA, Subclause 7.2 revised

English Version

Chimneys - Design, installation and commissioning of chimneys - Part 1: Chimneys for non-roomsealed heating appliances

Conduits de fumée - Conception, installation et mise en
oeuvre des conduits de fumée - Partie 1: Conduits de fumée
pour appareils qui dépendent de l'air dans la pièce

Abgasanlagen - Planung, Montage und Abnahme von
Abgasanlagen - Teil 1: Abgasanlagen für
raumluftabhängige Feuerstätten

This European Standard was approved by CEN on 28 July 2007 and includes Amendment 1 approved by CEN on 28 July 2010.

CEN 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 Management Centre or to any CEN 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 member into its own language and notified to the CEN Management Centre has the same status as the official versions.

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



EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: Avenue Marnix 17, B-1000 Brussels

Contents

Page

Foreword.....	3
Introduction	4
1 Scope	5
2 Normative references	5
3 Terms and definitions	6
4 Design	11
5 Installation	25
6 Commissioning/handover.....	26
Annex A (informative) Determination of the chimney designation for custom-built and relined chimneys	27
Annex B (informative) List of heating appliance data required for the design of a chimney.....	39
Annex C (informative) Example of a chimney designation.....	40
Annex D (informative) Correlation between designation parameters for clay/ceramic flue liners and clay/ceramic flue blocks and concrete flue liners and concrete flue blocks.....	41
Annex E (informative) Designation of metal system chimneys and correlation between metal liner material specification and corrosion load in Member States (MS).....	43
Annex F (informative) Example of typical building structure designed to assist exchange of information	49
Annex G (informative) Examples of a chimney plate.....	52
Annex H (normative) Determination of a chimney designation for an installed metal system chimney	53
Annex I (informative) Example for the determination of the designation of a relined chimney using a metal flue liner.....	54
Annex J (informative) Example for the determination of the designation of a custom-built chimney using a clay/ceramic flue liner.....	60
Annex K (normative) Determination of the designation for an installed metal connecting flue pipe	65
Annex L (informative) Recommendations for inspection, cleaning and maintenance	66
Annex M (informative) Location of the chimney outlet	67
Annex N (informative) Calculating the temperature of adjacent material	71
Annex O (informative) Chimney commissioning	74
Annex P (informative) Useful hints for checking, handling and site storage of materials and components.....	77
Bibliography.....	79
National Annex NA (informative) Recommendations for the installation of chimneys and flues for domestic appliances burning solid fuel (including wood and peat).....	80
National Annex NB (informative) Remedial action for defective chimneys	115
National Annex NC (informative) Chimney and flue pipe cleaning and maintenance	117
National Annex ND (informative) Designation.....	122
National Annex NE (informative) Chimneys to be used with gas and oil appliances	124

Foreword

This document (EN 15287-1:2007+A1:2010) has been prepared by Technical Committee CEN/TC 166 “Chimneys”, the secretariat of which is held by UNI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by February 2011, and conflicting national standards shall be withdrawn at the latest by February 2011.

This document includes Amendment 1, approved by CEN on 2010-07-28.

This document supersedes  EN 15287-1:2007 .

The start and finish of text introduced or altered by amendment is indicated in the text by tags  .

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

This document is one of a series of specifications as listed below:

Chimneys — Design, installation and commissioning of chimneys — Part 1: Chimneys for non-roomsealed heating appliances.

Chimneys — Design, installation and commissioning of chimneys — Part 2: Chimneys for roomsealed heating appliances.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

Introduction

CEN/TC 166 started with its programme on standardization of chimneys approximately 15 years ago, with standards for interfaces, for products, for test and last but not least for design, installation, construction and commissioning matters.

For the work program in the last years first priority had been given to product and test standards.

In the meantime most of the product and test standards are published or nearly ready to be published. In order to introduce the products, which are tested and certified in accordance with the relevant European Standards, in an easy way on the markets of the different countries, some common rules for design, installation, and commissioning especially with reference to the designation of a chimney are helpful.

Firstly CEN/TC 166/SC 2 started the work on execution standards for metal chimneys. The first standard had been already published as EN 12391-1 in 2003.

In order not to repeat this work in all material oriented WGs and SCs, CEN/TC 166 decided in 2002 to give the task to WG 1 to develop a material independent design, installation and commissioning standard.

CEN/TC 166/WG 1 started the work in 2003 and decided first to write two documents, one for chimneys connected to non-roomsealed heating appliances and one for chimneys connected to room-sealed heating appliances. Working on the documents there were two strong positions, one for a Technical Specification (TS) and one for a European Standard (EN).

Following the proposal of CEN/TC 166/WG 1, CEN/TC 166 decided to launch a vote on the question which of the two positions should apply. The CEN/TC 166 members had been in favour of creating European Standards (EN).

1 Scope

This European Standard describes the method of specifying the design, installation criteria for system chimneys, construction of custom built chimneys, and the relining of existing chimneys. It also gives information on commissioning of chimneys.

This European Standard also deals with connecting flue pipes.

This European Standard does not apply to freestanding chimneys covered by EN 13084-1.

This European Standard excludes chimneys designated H (high positive pressure chimneys) and chimneys for room-sealed heating appliances.

For the purpose of this European Standard the term "installation" includes construction.

2 Normative references

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

EN 1443:2003, *Chimneys — General requirements*

EN 1457, *Chimneys — Clay/ceramic flue liners — Requirements and test methods*

EN 1806, *Chimneys — Clay/ceramic flue blocks for single wall chimneys — Requirements and test methods*

EN 1856-1, *Chimneys — Requirements for metal chimneys — Part 1: System chimney products*

EN 1856-2, *Chimneys — Requirements for metal chimneys — Part 2: Metal liners and connecting flue pipes*

EN 1857, *Chimneys — Components — Concrete flue liners*

EN 1858, *Chimneys — Components — Concrete flue blocks*

EN 12446, *Chimneys — Components — Concrete outer wall elements*

EN 13063-1, *Chimneys — System chimneys with clay/ceramic flue liners — Part 1: Requirements and test methods for sootfire resistance*

EN 13063-2, *Chimneys — System chimneys with clay/ceramic flue liners — Part 2: Requirements and test methods under wet conditions*

EN 13063-3, *Chimneys — System chimneys with clay/ceramic flue liners — Part 3: Requirements and test methods for air flue system chimneys*

EN 13069, *Chimneys — Clay/ceramic outer walls for system chimneys — Requirements and test methods*

EN 13084 (all parts), *Free-standing chimneys*

EN 13384-1:2002, *Chimneys — Thermal and fluid dynamic calculation methods — Part 1: Chimneys serving one appliance*

EN 13384-2, *Chimneys — Thermal and fluid dynamic calculation methods — Part 2: Chimneys serving more than one heating appliance*

EN 13502, *Chimneys — Requirements and test methods for clay/ceramic flue terminals*

EN 14297, *Chimneys — Freeze-thaw resistance test method for chimney products*

EN 14471, *Chimneys — System chimneys with plastic flue liners — Requirements and test methods*

EN 14989-1, *Chimneys — Requirements and test methods for metal chimneys and material independent air supply ducts for roomsealed heating applications — Part 1: Vertical air/flue terminals for C6-type appliances*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 1443:2003 together with the following apply.

NOTE Examples of chimney construction identifying individual component terminology and definitions are given in Figures 1, 2 and 3.

3.1
access component
component installed in the chimney or in the connecting flue pipe to provide access to the flue for the purpose of inspection or cleaning

3.2
back ventilation
ventilation in the space between flue liner and the outer wall of the chimney or an enclosure to evacuate the products of combustion which can escape from the flue liner in positive pressure multi-wall systems

3.3
centralising spacer
component to centralise the liner

3.4
chimney adapter
component which connects a chimney to a connecting flue pipe or an heating appliance

3.5
condensate drain
component to facilitate the disposal of condensate

3.6
damper
device used to close or partially close the flue

3.7
draught regulator
balanced hinged flap in a flue opening to allow airflow into the chimney to control draught at the boiler outlet

3.8
elbow
chimney fitting which provides a change of direction of the flue

3.9
explosion relief
device that protects the chimney against overpressure arising from deflagration or explosion in the flue

3.10
fire compartment
part of the building being isolated to provide resistance to fire

3.11

fire stop

component intended to provide resistance to fire spread between rooms or compartments

3.12

flashing

component or site fabricated materials used for weatherproofing the penetration of the roof by the chimney

3.13

flexible liner

tube having a single or multi-skin construction that is able to bend in any direction without permanent deformation

3.14

heating appliance adapter

component which connects the connecting flue pipe or the chimney to a heating appliance

3.15

rain cap

part of the chimney that protects against the entry of rain. This can be a part of a terminal

3.16

rigid liner

straight liner that cannot bend without permanent deformation

3.17

rain seal

part of the chimney that stops the entry of rain into the insulation space

3.18

seal

device that joins two elements in such a way as to prevent leakage

3.19

sealant

material which, applied in an unformed state to a joint, seals it by adhering to appropriate surfaces within the joint

3.20

silencer

component installed to provide noise attenuation

3.21

sleeve

component which provides an aperture through a wall, ceiling or floor through which a chimney or a connecting flue pipe passes

3.22

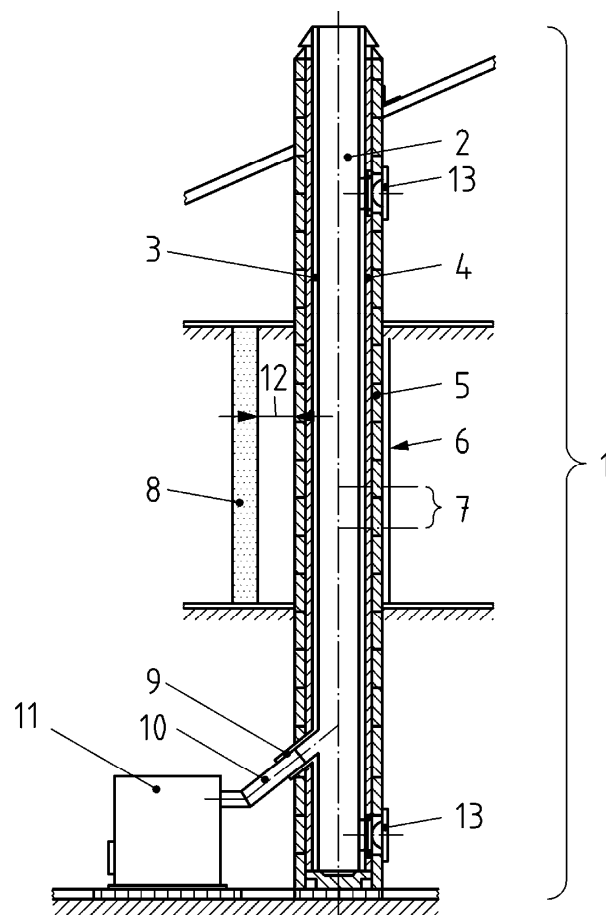
test point

component that provides access for flue gas sampling and measurement

3.23

T-piece

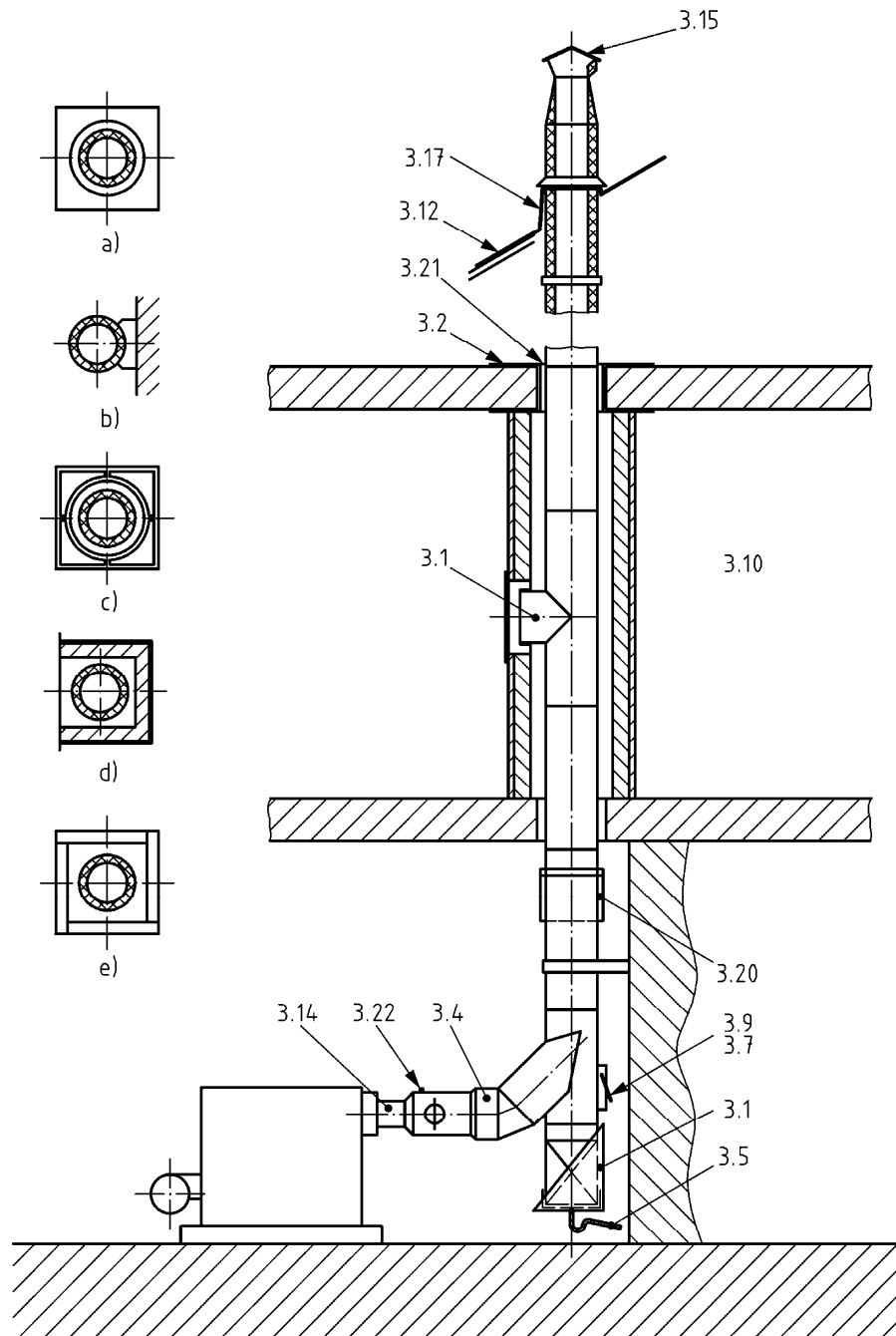
chimney fitting which allows a heating appliance, connecting flue pipe or accessory to be connected to the chimney flue at an angle



Key

- | | |
|---|--|
| 1 chimney | 7 chimney section |
| 2 flue | 8 adjacent combustible wall or enclosure or cladding |
| 3 flue liner | 9 chimney fitting |
| 4 thermal insulation | 10 connecting flue pipe |
| 5 outer wall | 11 heating appliance |
| 6 non-combustible enclosure or cladding | 12 distance to combustible material |
| | 13 access component |

Figure 1 — Chimney components and chimney accessories of a multi-wall chimney



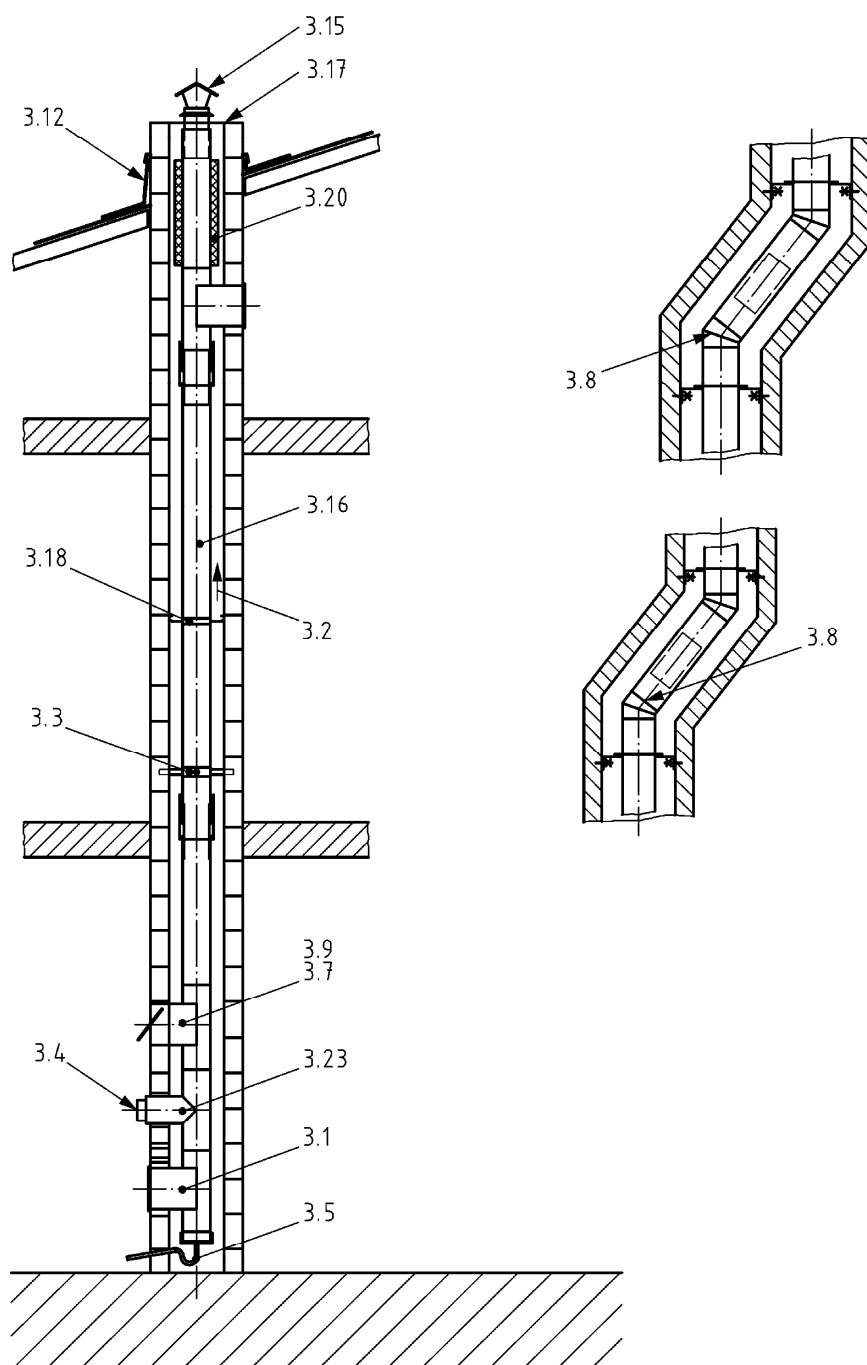
Key

see Clause 3

- a chimney in a solid block shaft
- b internal or external chimney without enclosure
- c chimney in a cavity block
- d chimney in a shaft or an enclosure as a part of the building structure
- e chimney in a separate enclosure

Figure 2 — Terminology for a system chimney

NOTE The liner may be of clay, concrete, metal or plastic.



Key
see Clause 3

Figure 3 — Terminology for a custom-built or a relined chimney

NOTE The liner may be of clay, concrete, metal or plastic.

4 Design

4.1 General

In order to design a chimney installation the following steps should be followed to achieve a safe chimney installation.

Chimneys shall comply with national regulations and nationally accepted rules.

4.2 Data requirements

4.2.1 Sources of data and information

The data and information specified in 4.2.2 to 4.2.6 shall be obtained and documented as appropriate.

NOTE The sources can be:

- heating appliance manufacturers catalogues and literature;
- chimney manufacturers literature including installation instructions;
- architects drawings or plans and/or site surveys;
- local building rules.

A possible source of typical or average data is in Annex A and in EN 13384-1.

4.2.2 Heating appliance information

The information for the heating appliance(s) (see Annex B for an example) shall be obtained from the documentation of the heating appliance manufacturer or if not available, default values may be used (see EN 13384-1:2002, Annex B), but the source of the data shall be documented in the design (see 4.2.1).

4.2.3 Chimney product specification

The following information about the chimney product specification shall be obtained (see 4.2.1):

- identification and designation of the system chimney or of the components for custom built chimneys or for relining an existing chimney, see also Annex C, Annex D and Annex E;
- design load or maximum allowed chimney height to be supported by lengths, fittings and supports;
- mass of components;
- manufacturer's installation instruction;
- additional information for chimney sizing (see EN 13384-1).

4.2.4 Building construction and chimney route information

In order to allow the chimney route to be determined the relevant details of the building or support structure shall be obtained (see Figure F.1).

If the chimney is to be supported by the building structure, the construction of the building and the materials used shall be capable of supporting the loads imposed upon it by the chimney. The fixings shall be compatible with the materials of construction of the building. This shall be checked before installing the chimney.

A check list of information is given in Annex F.

4.2.5 Local conditions

Environmental and topographical particulars of the site shall be obtained.

4.2.6 Combustion air supply

Information on the size and position of apertures for combustion air supply into the room containing the heating appliance shall be obtained (possible sources of data are given in 4.2.1).

4.3 Design requirements

4.3.1 General

The design of the chimney installation shall be detailed and documented. Manufacturers' product information may fulfil this requirement. The design should enable a chimney product manufacturer's standard components to be used in carrying out the installation. Modification of components, e.g. producing openings or adjustments of length may only be undertaken in accordance with the manufacturer's instructions.

NOTE The finished chimney should have a designation in accordance with EN 1443 (see Annex C). The chimney products should be chosen so that the designation reflects the suitability of the chimney for the intended use. Annex E gives an example for the designation of a metal system chimney and Annex A gives an example of the general designation of a chimney according EN 1443. The finished chimney should have a chimney plate (see Annex G).

4.3.2 Designation

The chimney and connecting flue pipe shall have designation classes appropriate to the heating appliance data as required in 4.2.2 and the building structure data as required in 4.2.4.

The connecting flue pipe may have a designation different from that of the chimney i.e. where the heating appliance output results in a positive pressure in the connecting flue pipe.

Each designation parameter shall be of a class at least equal to that required or shall be of a higher class according to the following sequence:

- $T600 > T450 > T400 > T300 > T250 > T200 > T160 > T140 > T120 > T100 > T080$;
- $H > P > N$;
- $W_x > D_x$;
- $D3 > D2 > D1$;
- $W3 > W2 > W1$;
- $G > O$;

where

- T* is the temperature class;
- P* is the positive pressure class;
- N* is the negative pressure class;
- O* is without soot fire resistance;
- G* is with soot fire resistance;
- xx* is the distance to combustibles;

and for corrosion class:

- W* is wet operating conditions;
- D* is dry operating conditions;
- 1 is for gas and kerosene with a sulphur content $\leq 50 \text{ mg/m}^3$;
- 2 is for light oil / wood in open fires;
- 3 is for heavy oil / wood in closed stoves / coal and peat.

4.3.3 Determination of designation of the chimney and connecting flue pipe

4.3.3.1 General

The chimney shall be assigned designations according to EN 1443 (see Annex C).

4.3.3.2 System chimney

The designation of an installed system chimney shall be according to the product standard EN 13063-1 and EN 13063-2 for clay/ceramic products and EN 1858 for concrete products.

The designation of an installed metal system chimney according to EN 1856-1 shall be according to Annex H.

The designation of an installed plastic system chimney shall be according to the product standard EN 14471 excluding the location, reaction to fire and enclosure parameters.

4.3.3.3 Custom-built and relined chimney

The designation of a custom-built or a relined chimney shall be determined. The methods to determine the designation is according to the calculations of Annex A or according to national regulations or nationally accepted rules.

The temperature class, the sootfire class and the distance to combustible material given in the designation of a chimney product may be used for the custom-built chimney designation.

NOTE Examples for the determination of the designation of relined and custom built chimneys are given in Annex I and Annex J.

4.3.3.4 Connecting flue pipe

The designation of metal connecting flue pipes according to EN 1856-2 shall be determined according to Annex K. The designation of connecting flue pipes made of system chimney components, e.g. EN 1856-1, EN 13063-1 and EN 14471 shall be determined according to 4.3.3.2. The designation of connecting flue pipes constructed in a custom-built manner, e.g. using glass, fibre products, or clay products such as bricks, should be determined according to Annex A.

4.3.4 Materials of construction

4.3.4.1 General

Supplementary materials not supplied with the chimney products shall be fit for purpose (e.g. in terms of corrosion, temperature and strength), jointing compounds (e.g. cements, mortars and seals), rendering, waterproofing/sealing materials, fixings, screws or additional supports.

4.3.4.2 System chimneys

System chimneys shall be in accordance with EN 1856-1, EN 1858, EN 13063-1, EN 13063-2 and EN 14471.

4.3.4.3 Relined chimneys

4.3.4.3.1 Flue liners

Flue liners for relining shall be made from rigid flue liners according to the requirements of EN 1457, EN 1856-2 and EN 1857, or flexible flue liners according to the requirements of EN 1856-2.

Positive pressure and wet designated flue liners and fittings (i.e. access component), including any seals/sealants shall be confirmed as a combination for that pressure class and condensate resistance class.

Chimney products according to the requirements of EN 1806, EN 1856-1, EN 1858 and EN 14471 may also be used as liners.

4.3.4.3.2 Insulation

Any insulation between the new liner and the outer wall shall be either rigid or be loose material and be approved to be fit for the intended use or be an air gap or according to national regulations or nationally accepted rules.

The thermal resistance or the thermal conductivity of the insulation shall be obtained from the product manufacturer, or in the absence of this information, typical values for the thermal conductivity are given in Annex A.

NOTE 1 Care should be taken when using loose infill without binders to prevent the risk of flue blockage arising from the escape of the insulation into the flue, e.g. by choosing a material with adequate corrosion resistance and allows free movement of the flue liner.

Loose infill with binders shall not prevent free movement of the liner.

NOTE 2 To determine the effect of a closed air gap see Table A.3 or the alternative calculation.

NOTE 3 To determine the effect of an open air gap an external heat transfer coefficient of $8 \text{ W}/(\text{m}^2 \cdot \text{K})$ should be used in the calculation for heat transfer (see EN 13384-1). Any additional insulation outside of the air gap is excluded in the calculation.

4.3.4.3.3 Outer wall

The existing chimney will become the outer wall of the relined chimney. The existing chimney shall be checked that it is fit for relining purposes. Any repair of the existing chimney or its outer wall (e.g. for resistance to fire, gas tightness purposes) shall be in accordance with the national regulations or nationally accepted rules. Typical values for the thermal conductivity are given in Annex A.

4.3.4.4 Custom-built-chimneys

4.3.4.4.1 Flue liners

Flue liners for custom-built chimneys shall be made from rigid flue liners in accordance with the requirements of EN 1457, EN 1856-2 and EN 1857.

For positive pressure and wet applications flue liners and fittings (i.e. access component), including any seals/sealants shall be confirmed as a combination for that pressure class and condensate resistance class.

Chimney products in accordance with the requirements of EN 1806, EN 1856-1, EN 1858 and EN 14471 may also be used as liners.

4.3.4.4.2 Insulation

Any insulation between the liner and the outer wall shall be either rigid or be loose material and be approved to be fit for the intended use or be an air gap or according to national regulations and nationally accepted rules.

The thermal resistance or the thermal conductivity of the insulation shall be obtained from the product manufacturer, or in the absence of this information. Typical values for the thermal conductivity are given in Annex A.

NOTE 1 Care should be taken when using loose infill without binders to prevent the risk of flue blockage arising from the escape of the insulation into the flue, e.g. by choosing a material with adequate corrosion resistance and allows free movement of the flue liner.

Loose infill with binders shall not prevent free movement of the liner.

NOTE 2 To determine the effect of a closed air gap see Table A.3 or the alternative calculation.

NOTE 3 To determine the effect of an open air gap an external heat transfer coefficient of $8 \text{ W/(m}^2\text{K)}$ should be used in the calculation for heat transfer (see EN 13384-1). Any additional insulation outside of the air gap is excluded in the calculation.

4.3.4.4.3 Outer wall

Chimney products in accordance with EN 12446, EN 1806, EN 1858 and EN 13069 may be used as outer wall components. Other products may be used, e.g. brick, steel, concrete according to national regulations or nationally accepted rules. Performance characteristics for some products are given in Annex A.

4.3.4.5 Connecting flue pipe and adapters

The material of the metal connecting flue pipe shall comply with EN 1856-2. System chimney components including adapters complying with EN 1856-1, or EN 14471 can also be used. Flexible flue liners complying with EN 1856-2 can also be used as connecting flue pipes where permitted in accordance with national regulations. Connecting flue pipes and adapters may also be constructed in a custom-built manner, e.g. using glass, fibre products, or even clay products such as bricks, according to national rules.

4.3.4.6 Supplementary components or additional materials

Supplementary components or additional materials shall have performance characteristics appropriate to the designation of the chimney components, which affect them e.g. insulation operating temperatures.

4.3.5 Flue size

The flue for the chimney and the connecting flue pipe shall be sized to suit the heating appliance which it serves. The method for sizing the flue should be based on the thermal and fluid dynamic calculation methods of EN 13384-1 and EN 13384-2.

NOTE 1 EN 13384-1 describes a calculation method for chimneys serving one appliance.

NOTE 2 EN 13384-2 describes a calculation method for chimneys serving more than one appliances.

NOTE 3 The chimney manufacturer or the heating appliance manufacturer may specify a flue size, but this should not conflict with the size range calculated according to either EN 13384-1 or EN 13384-2 as appropriate.

4.3.6 Chimney route

The chimney route should be determined by the positions of the heating appliances the flue outlet position, air supply intake and the point of chimney termination.

The chimney route should be the shortest, most direct route between the heating appliance outlet and the chimney termination and should be straight and vertical wherever possible, with the termination being as near to the highest part of the building (e.g. ridge) as practicable to ensure adequate draught and dispersion of flue gas.

The chimney route selected should enable the chimney manufacturer standard components to be used in carrying out the installation, including offsets to be supported in compliance with the manufacturer's installation instructions.

Attention should be given to heat emitted from the chimney in applications where whole year operation is likely to affect comfort.

NOTE A thermal resistance of at least $0,22 \text{ m}^2 \cdot \text{K/W}$ is recommended for temperature class T300 and above.

4.3.7 Connecting flue pipe route

The connecting flue pipe shall not pass through a ceiling or into another fire compartment or spaces which cannot be inspected.

A connecting flue pipe designated suitable for wet operating conditions, shall be inclined to allow condensate to be drained.

NOTE 1 It is recommended that it should be inclined at least $2,5^\circ$ to the horizontal.

NOTE 2 It is recommended that the connecting flue pipe should be as short as possible.

NOTE 3 It is recommended that the angle of entry of the connecting flue pipe into the chimney should not exceed 45° measured between the axis of the connecting flue pipe and the vertical axis of the chimney.

NOTE 4 For gas heating appliances type B₁ according to CEN/TR 1749 a vertical run of flue directly above the draught diverter, sufficient to prevent spillage from the heating appliance, should be provided unless otherwise stated in the heating appliance manufacturers installation instructions.

The heating appliance manufacturer's installation instructions shall be followed for any specific requirements.

Attention should be given to heat emitted from the connecting flue pipe in applications where whole year operation is likely to affect comfort.

NOTE 5 A thermal resistance of at least $0,22 \text{ m}^2 \text{ K/W}$ is recommended for temperature class T300 and above.

4.3.8 Resistance to fire (external to external)

A chimney design shall enable the resistance to fire (external to external) required for the specific parts of the building through which it passes to be achieved. The required resistance to fire shall be classified in terms of EI (Integrity and insulation). This may be achieved by one of the following:

- chimney itself with the required resistance to fire;
- chimney built into a shaft with the necessary resistance to fire (e.g. non-combustible enclosure);
- chimney and its enclosure which together fulfil the necessary resistance to fire.

In the absence of specified European tests the resistance to fire shall be tested according to national regulations for preventing the spread of fire.

This also applies to an installation design which requires the use of fire stops, including those that act as combined fire stops and spacers or as ceiling/floor supports according to national regulations

4.3.9 Distance to combustible material (resistance to fire – internal to external)

4.3.9.1 System chimneys

The minimum distance to combustible materials for a system chimney shall be as declared by the manufacturer in accordance with the relevant product standards or according to national regulations, whichever is the greater distance.

A system chimney which passes through a combustible wall or ceiling shall be sleeved and/or shielded and/or separated to maintain the appropriate distance to combustible material or in the case of cavity wall construction to contain any infill. Any sleeve or shield opening to the outside of the building shall be weatherproofed.

The distance to combustible materials may be reduced where the expanse of the combustible material is small, e.g. skirting boards, rafters, joists. In some circumstances the combustible material may touch. This shall only be allowed by individual member state's regulation.

4.3.9.2 Custom-built and relined chimneys

The minimum distance to combustible materials for a custom-built chimney and a relined chimney shall either be as declared by the chimney product manufacturer, or by calculation, or according to the national regulations if it gives the greater distance. A calculation method is given in A.8.

NOTE 1 Equation A.1 covers the case of non-ventilated spaces between the chimney and combustible material and gives the maximum allowed flue gas temperature for a given distance.

NOTE 2 Equation A.2 covers the case of ventilated spaces between the chimney and combustible material and gives the maximum allowed flue gas temperature for a specified gap.

A custom-built chimney which passes through a combustible wall shall be sleeved and/or shielded to maintain the appropriate distance to combustible material or in the case of cavity wall construction to contain any infill. Any sleeve or shield opening to the outside of the building shall be weatherproofed.

The distance to combustible materials may be reduced where the expanse of the combustible material is small, e.g. skirting boards, rafters, joists etc. In some circumstances the combustible material may touch. A reduction in the distance shall only be allowed by individual member state's regulation.

NOTE 3 A chimney relined with a liner having the same characteristic may retain the existing distance to combustible material.

4.3.9.3 Connecting flue pipe

Where metal connecting flue pipes in accordance with EN 1856-2 are used, the given minimum distance to combustible materials declared by the manufacturer shall be used.

Other connecting flue pipes in temperature classes T100 to T160 should be at a minimum distance of 50 mm from combustible materials, when installed in natural ventilated conditions or at a distance as calculated in Equation A.1 of A.3.

Naturally ventilated metal connecting flue pipes with a temperature class equal to or higher than T200 shall either be installed at a minimum distance to combustible materials of at least three times their nominal diameter but not less than 375 mm or the distance specified in the national regulation. The minimum distance to combustible material may be reduced to 1,5 times the nominal diameter but not less than 200 mm, if a radiation shield creating an air gap, made from non combustible material, is installed between the connecting flue pipe and the adjacent combustible materials.

For connecting flue pipes made of chimney products the minimum distance to combustible materials shall be according to 4.3.9.1 and 4.3.9.2.

NOTE Connecting flue pipes in temperature class T080 do not require a minimum distance to combustible materials. However, direct contact with combustible material is not recommended.

A connecting flue pipe that passes through a combustible wall shall be sleeved and/or shielded to maintain the appropriate distance to combustible material or in the case of cavity wall construction to contain any infill. Any sleeve or shield opening to the outside shall be weatherproofed.

The minimum distance to combustible material may be reduced by insulation. For example the minimum distance may be reduced to 10 cm, if the connecting flue pipe has a thermal insulation with at least 2 cm thickness and a thermal conductivity of 0,04 m²K/W.

4.3.10 Accidental human contact

Where the chimney is not otherwise completely enclosed and there is a risk of accidental human contact causing burning (see Table A.6), the design shall incorporate a shield or safety guard. It shall be fitted in accordance with the chimney manufacturer's instruction.

4.3.11 Accidental ignition of extraneous loose material

Where the chimney is not otherwise completely enclosed and there is a risk of ignition of extraneous loose material by combustible material being placed adjacent to the chimney, the design shall incorporate a shield or safety guard. It shall be fitted in accordance with the chimney manufacturer's instruction.

4.3.12 Supports

The limitations of height and separation from buildings regarding free-standing externally installed chimney sections are given in 4.3.18. The heating appliance shall not support the weight of the chimney except when the heating appliance manufacturer states in his instruction that the load bearing capacity is sufficient and where cleaning of the chimney can be undertaken without dismantling.

The liner manufacturer's instructions for supporting the liner shall be followed. Where the liners are to be supported on a lintel or foundations at the base of the chimney they shall be adequate for the liner load, including any condensate collectors, cleaning and inspection elements, and T-pieces or elbows.

4.3.13 Joints

Joints shall be made in accordance with the manufacturer's instructions.

The design shall be such that joints between system chimney sections in accordance with EN 1856-1 shall not be placed inside a ceiling or floor.

4.3.14 Chimney offsets

The design shall ensure that offsets are supported in accordance with the manufacturer's instructions, or with adequate supports and provision made for expansion.

4.3.15 Access for cleaning, inspection and measuring

Access shall be available so that the full length of the chimney from the heating appliance adapter to the chimney outlet can be inspected and where it is required the chimney can be cleaned (see Annex L).

Access for cleaning may be possible from the bottom or the top of the chimney, the loft access, explosion relief door, connecting flue pipe or through the heating appliance, but shall be in accordance with the heating appliance or chimney manufacturer's instructions where approved.

The fittings used to provide an access shall be a component compatible with a chimney or liner.

An access shall be located only in areas where there is no risk from fire or explosion.

NOTE Where a chimney is to be cleaned from the top a safe working environment should be available.

An access shall be provided in the vicinity of offsets of more than 30° or any offset which otherwise could not be inspected or cleaned.

Where not provided in association with the heating appliance a closable pressure tight test point should be provided in the connecting flue pipe. It is recommended that such a measuring point be positioned at a distance of twice the internal diameter in straight length from the heating appliance outlet.

4.3.16 Distance between openings in the chimney

Openings such as for cleaning access, draught regulators and any heating appliance connection into the same flue shall be separated by at least one nominal diameter from one another except where the configuration for such openings are otherwise demonstrated to evacuate products of combustion adequately.

4.3.17 Back ventilation

Where back ventilation is required between the liner and the next wall of the chimney construction (e.g. to evacuate the products of combustion which may escape from the flue liner in positive pressure multi-wall system), the gap between the liner and the next wall of the chimney construction shall be sufficient to ensure adequate ventilation (see notes). The ventilation of the space shall be continuous from the boiler room or the bottom of the chimney to the outside atmosphere.

NOTE 1 The recommended minimum gap between the liner and the next wall of the chimney construction is 30 mm except where a circular liner is bounded by a square section wall, the minimum gap may be 20 mm.

The gap air inlet and outlet apertures and/or grills to the ventilation gap shall not restrict the back ventilation.

NOTE 2 The gap air inlet to the cavity should have the same flow area as the cross section of the ventilated gap.

Access should be provided for inspecting and where necessary cleaning the gap.

4.3.18 Location of chimney outlet

The chimney outlet shall be positioned to allow adequate evacuation and dispersal of combustion products and to avoid re-entry through openings into the building.

The location of the chimney outlet shall be in accordance with national regulations and nationally accepted rules.

Where no national requirements exist, Annex M gives an example for chimney outlet positions for residential heating or comparable applications, which has been developed on the basis of typical known national rules.

Adequate evacuation of the products of combustion is confirmed by the calculation of EN 13384-1 and EN 13384-2 which takes into account the location of the chimney outlet and the effects of the outlets being in the pressure zone.

The chimney outlet is considered to be in an adverse pressure zone if the chimney outlet position is less than 0,4 m above the ridge and the distance of a horizontal line from the chimney outlet to the intersection with the roof is less than 2,3 m, and the chimney outlet is situated:

- on a roof with a slope of more than 40°, or
- on a roof with a slope of more than 25° if the opening for combustion air and the top of the chimney are on different sides of the ridge and horizontal distance from the top to the ridge is more than 1,0 m.

NOTE 1 A chimney can also be considered to be adversely affected by the proximity of adjacent obstructions e.g. buildings, trees, mountains. A chimney outlet within 15 m from adjacent structures which extends over a horizontal angle of 30° and their upper boundary raises more than 10° above the horizon as seen from the terminal outlet can be affected by wind turbulence. This can be overcome by an aerodynamic terminal.

Other dimensions, e.g. the prohibited zone, are related to environmental issues and not the functioning capability of the chimney.

NOTE 2 For other applications e.g. involving industrial heating plant or process venting, the determination of the chimney outlet position can require other criteria, such as calculations for the dispersal of combustion products related to nearby surroundings.

4.3.19 External parts

4.3.19.1 General

The maximum allowed height of external parts of chimneys shall be subject to the following limiting conditions as specified in EN 13084-1:

- horizontal distance between the building and the chimney outer wall not to exceed 1 m;
- distance between the supports not to exceed 4 m;
- distance above the last structural attachment not to exceed 3 m.

4.3.19.2 System chimneys

The maximum height of external parts of system chimneys shall be in accordance with the relevant product standards EN 1856-1, EN 1858, EN 13063-1, EN 13063-2, EN 13063-3 and EN 14471.

The spacing of supports and unsupported height declared by the manufacturer shall not be exceeded.

Chimneys in accordance with EN 1858 shall have a maximum unsupported height of 4,5 times the least cross sectional dimension, but not higher than 3 m.

4.3.19.3 Custom-built-chimneys

If not otherwise proven, e.g. to the relevant part of the series EN 13084, the maximum height of external sections of custom-built chimneys shall be in accordance with national regulations or nationally accepted rules or for:

- metal chimneys, not more than 1,5 m above the last support, if the thickness of the load carrying wall has a minimum thickness equal to $1/200$ of the diameter and the distance between lateral supports below external sections does not exceed 2 m;
- chimneys having a masonry outer wall, a maximum unsupported height of 4,5 times the least cross sectional dimension, but not more than 3 m, and shall not exceed 2,5 m or be supported according to the outer wall element product standards EN 13069 (clay) or EN 12446 (concrete).

The distance above the last attachment to a building may be extended by propping, use of lateral supports or guy wires or use of masts;

NOTE All props, struts, guy wire designs and masts should be in accordance with EN 1993-3-2;

The wall supports of custom-built-chimneys shall be rigid against lateral movement when fixed.

Wall fixings shall be used in accordance with manufacturer's instructions and be suitable for the materials of the construction of the wall which itself shall be capable of transmitting the load to earth.

4.3.20 Weatherproofing

Where the chimney passes through a roof or wall a proprietary component or material shall be used to provide weatherproofing, at the appropriate angle of the roof slope and only the correct components shall be used. Where flashings are constructed on site, the design and application shall be in accordance with the roof and chimney design.

Where rain penetration is a problem weatherproofing of the chimney may be by cladding, rendering, or painting, according to the design and compatible with the substrate taking into account any freeze-thaw requirements.

Weatherproofing shall be undertaken with materials having a temperature capability appropriate to the outer wall surface temperature.

Where the chimney is sootfire designated and where there is a risk of spark ignition the weatherproofing material shall be non-combustible.

NOTE The outer surface temperature may be taken from the manufacturer's product information or calculated using one of the equations in Annex N.

Where the weatherproofing material has a higher water vapour diffusion resistance than the chimney construction, back ventilation may be required between the outer wall of the chimney and the weatherproofing construction.

Where the system or design requires back ventilation, the weatherproofing shall not cause a restriction to the back ventilation.

If parts of the chimney are to be painted the paint system shall be compatible with the substrate.

4.3.21 Lightning protection

Where lightning protection for the building is required, the chimney shall also have lightning protection, either separately or via the lightning protection for the building. A metal chimney shall not be used as lightning protection.

4.3.22 Earthing of chimneys

Consideration should be given to earthing protection of metal chimneys in accordance with national regulations or nationally accepted rules.

4.3.23 Draught regulator

If a draught regulator is installed it should be in the same compartment as the heating appliance or the lowest room.

4.3.24 Explosion relief

If required, the explosion relief shall be in the same compartment as the heating appliance. It shall be guarded and positioned so as to prevent a hazard when operating and shall be self-resetting.

4.3.25 Silencer

Where noise transmission between the heating appliance and the chimney occurs; an appropriate noise attenuation system (silencer) is recommended.

When a silencer is installed, the pressure loss characteristic and its influence on system capacity shall be included in the flue size calculation (see 4.3.5). The silencer shall have its own structural support as required by the manufacturer.

4.3.26 Condensate drainage system

Consideration should be given to condensate disposal.

Where the condensate is to be discharged into the public drainage system national regulations or nationally accepted rules apply.

NOTE A neutraliser to control acidity may be required.

Where condensation from the flue gas is expected and it is not intended to drain this condensate through the heating appliance condensate drainage system a separate chimney condensate drainage system shall be fitted.

In positive pressure systems the condensate drainage shall have a pressure resistance of at least two times the positive pressure in the chimney. This pressure resistance may be obtained for example by installing a trap. Any pipe work shall have a minimum diameter of 12 mm as the connection in the drainage system. Where freezing is likely protection against freezing shall be provided.

4.3.27 Rain cap

Where rain water can enter the flue and is otherwise not disposed of (see 4.3.26) a rain cap may be provided, except as required by national regulations. The rain cap may be integral with a terminal.

Where ice formation is a risk (e.g. in condensing applications), terminals tested against ice formation shall be used (see EN 14989-1).

When a rain cap is installed the pressure loss characteristic and its influence on system capacity shall be included in the flue sizing (see 4.3.5).

4.3.28 Rainwater disposal

Where rainwater would be collected in the chimney or in the heating appliance a rainwater drainage system is recommended. It may be a condensate drainage system.

4.3.29 Flue damper

Where dampers are used for isolating the heating appliance from the chimney, only dampers supplied as part of the heating appliance or, where allowed by national regulations or nationally accepted rules, fitted in the connecting flue pipe and functionally interlocked with the heating appliance is permitted. Where dampers are used for adjusting the draught they shall be positively locked when set, and shall have a minimum setting or opening according to the heating appliance manufacturer's instructions and where allowed by national regulations or nationally accepted rules.

4.3.30 Exhaust fans

The fan shall be chosen to have a temperature capability, condensate and corrosion resistance appropriate to the chimney designation. The fan shall be sized, both for its physical dimensions and for its extract capacity, to ensure full clearance of combustion products including wind influences in accordance with EN 13384-1 or EN 13384-2.

Exhaust fans may be mounted in or on a chimney to assist the evacuation of products of combustion provided that:

- for gas and oil heating appliances the fan is interlocked for draught failure with the heating appliance according to the heating appliance manufacturers instructions;
- for mechanical solid fuel combustion the combustion system is interlocked and the chimney has enough capacity (draught) to evacuate the residual products of combustion to the outside atmosphere in the event of fan failure;
- for natural draught solid fuel heating appliances which have rapid response combustion, e.g. gravity fed boilers, the chimney without the fan running has the capacity to evacuate 20 % of the nominal heat output of the heating appliance.

Fans shall only produce positive static pressure in the chimney if the chimney and/or connecting flue pipe is designated for positive pressure operation. For chimneys designated for negative pressure operation the fans shall be positioned so that the fan cannot produce positive pressure in the chimney.

The fan and the connecting flues shall be positioned so that easy maintenance is possible.

The fan details can be taken from the fan plate or manufacturers information.

The fan shall have its own structural support. When necessary the additional structural loading on the chimney shall be included in the structural design.

NOTE Where the chimney is designated sootfire resistant the fan may be positioned in a by-pass arrangement, see Figure 4.

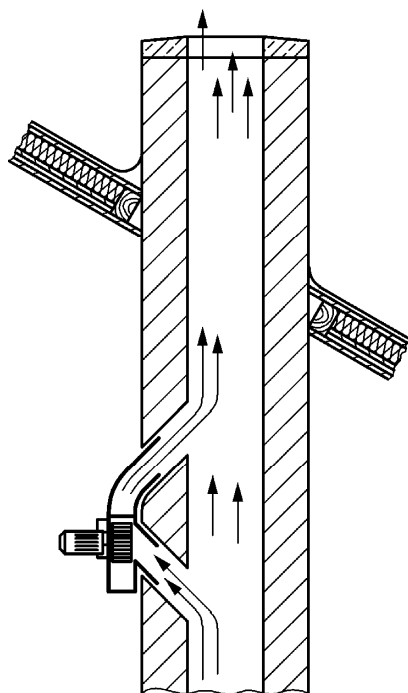


Figure 4 — By-pass arrangement

4.3.31 Terminals (for system chimneys and custom built chimneys)

The terminal shall be chosen to have a temperature, condensate, corrosion resistance and sootfire resistance capability appropriate to the chimney designation. A terminal which is installed in the pressure zone as defined in EN 13384-1 or EN 13384-2 shall have aerodynamic properties capable of evacuating combustion products taking into account wind influences.

Where required the terminals shall have freeze-thaw resistance in accordance with EN 14297 or EN 13502.

4.4 Chimney plate

The designer shall specify the contents of the chimney plate in accordance with national regulations or nationally accepted rules.

The plate shall be permanent and indelibly marked, e.g. engraved metal plate, impressed or printed plastic plate.

The plate shall carry a warning that the plate shall not be covered or defaced.

The following information should be included on the chimney plate where appropriate:

- chimney location;
- liner, or single wall block product manufacturer identification, e.g. CE marking information;
- for system chimneys the product designation according to EN 1856-1, EN 1858, EN 13063-1, EN 13063-2 and EN 14471;
- for custom built and relined chimneys the final chimney designation determined in accordance with 4.3.3;

- thermal resistance at the nominal working temperature;
- constructor identification (name/address/Tel.);
- date of construction.

And where appropriate, additional information, e.g. about external elements, which are not easily seen. Other information may be supplied for example with the handover documents.

Examples of a chimney plate are given in Annex G.

5 Installation

5.1 General

The design for system chimneys, custom built chimneys and relined chimneys and the product manufacturer's installation instructions shall be followed. The construction shall be in accordance with the national regulations or nationally accepted rules.

NOTE 1 It is recommended that the installation is done only by a competent person.

NOTE 2 Information on checking, handling and site storage of materials and components is given in Annex L.

Chimney components shall not be modified unless specifically allowed by the chimney component manufacturer.

Additional items shall not be attached which affect structural stability or function or cleaning capability, e.g. TV and radio aerials or wind turbines.

NOTE 3 Special attention should be paid to the following items:

- location of centralising spacers;
- pulling force/load on installing flexible liners;
- alignment of liners;
- alignment of fittings to avoid undue stress/strain.

NOTE 4 Attention is drawn to the need to comply with applicable local and national regulations.

5.2 Construction of relined chimneys

Sufficient openings in the existing chimney shall be prepared for the installation of the liner system into the chimney. The entry of the heating appliance connection/connecting flue pipe into the chimney shall be in accordance with 4.3.3.4.

Any opening in existing chimneys shall only be made with methods suitable to create a sufficient opening without damage of the existing structure.

For installation of the new liner from the top of the chimney a safe working area shall be available.

All openings shall be closed with suitable material to achieve the resistance to fire and thermal resistance required for the relined chimney appropriate to the application. Ensure that free movement of the liner is maintained.

5.3 Chimney plate

Missing information on the chimney plate shall be completed in accordance with 4.4. The chimney plate shall be fixed in a visible position.

NOTE 1 Possible locations are by the cleaning/inspection access, the side of the fireplace, at the chimney inlet or possibly by the electricity-gas-water-meter.

NOTE 2 The chimney plate may be supplied by the system chimney product manufacturer or liner manufacturer.

Examples of a chimney plate are given in Annex G.

6 Commissioning/handover

After finishing the chimney installation the chimney shall be commissioned to ensure that the chimney has been correctly installed.

In the absence of specific instruction from product manufacturers, a recommended checklist of items is given in Annex O.

On satisfactory completion of the commissioning all relevant documentation and recommendations for inspection, cleaning and maintenance (see Annex L) shall be handed over to the user or his agent.

Annex A (informative)

Determination of the chimney designation for custom-built and relined chimneys

A.1 General

This annex describes the calculations to determine the individual designation classes of a custom-built or relined chimney in accordance with EN 1443.

For clay/ceramic flue liners the correlation between the product designation and the designation in accordance with EN 1443 is given in Table D.1.

A.2 Normative references

EN 771-1, *Specification for masonry units — Part 1: Clay masonry units*

EN 771-2, *Specification for masonry units — Part 2: Calcium silicate masonry units*

EN 1859, *Chimneys — Metal chimneys — Test methods*

EN 13216-1, *Chimney — Test methods for system chimneys — Part 1: General test methods*

A.3 Temperature class

The chimney shall have a temperature class equal or higher than the maximum flue gas temperature at the heating appliance outlet as specified by the heating appliance manufacturer.

The temperature class is dependent on the materials in use and the outer surface temperature (see Figure A.1).

The temperature class shall be one of the following:

- a) temperature class determined from the lowest of following:
 - temperature equal or lower than the lowest usable temperature of any of the materials of the construction; the usable temperature shall be taken from the designation of a chimney component or, in the absence of this information, typical values may be taken from Table A.1;
 - temperature class of a concrete or clay construction tested in accordance with EN 12446 or EN 13069 respectively.

Table A.1 — Examples of materials used for insulation/outer wall of the chimney and their maximum allowed temperature class

Material	Maximum temperature class
Brick	T600
Concrete	T600
Stainless steel	T600
Aluminium	T200
Cast iron	T600
Fired clay	T600
Mineral wool	T400
Ceramic fibre	T600
Glass-fibre	T400
Mild steel	T600
Copper	T300

b) temperature class determined from the lowest of following:

- limiting flue gas temperature (t_{calc}) that will ensure the maximum temperature allowed on combustible material is not exceeded. This can be calculated using Equation (A.1) or Equation (A.2) depending on the distance from combustible materials and whether the gap between the chimney and the adjacent combustible materials is ventilated or not. Use Table A.2 to determine the temperature class;
- where human contact has to be considered and no safety guard is fitted the limiting flue gas temperature (t_{calc}) that will ensure the maximum outer surface temperature allowed for human contact is not exceeded. This can be calculated using Equation (A.2). Use Table A.2 to determine the temperature class.

Table A.2 — Permitted range of t_{calc} for each temperature class

Value of t_{calc}	Maximum temperature class
$t_{calc} \geq 100\text{ °C}$	T080
$t_{calc} \geq 120\text{ °C}$	T100
$t_{calc} \geq 150\text{ °C}$	T120
$t_{calc} \geq 170\text{ °C}$	T140
$t_{calc} \geq 190\text{ °C}$	T160
$t_{calc} \geq 250\text{ °C}$	T200
$t_{calc} \geq 300\text{ °C}$	T250
$t_{calc} \geq 350\text{ °C}$	T300
$t_{calc} \geq 500\text{ °C}$	T400
$t_{calc} \geq 550\text{ °C}$	T450
$t_{calc} \geq 700\text{ °C}$	T600

Equation (A.1) may be used for a known value of $(1/\Lambda)_w$ and a surface temperature of adjacent combustible materials of 85 °C. The thermal resistance of the test wall for chimneys according to EN 1859, EN 13216-1, EN 12446 is 3,0 m²/K/W.

$$t_{calc} = \frac{\frac{1}{\alpha_i} + \left(\frac{1}{\Lambda}\right) + \frac{D_h}{D_{ha}} \cdot \left(\frac{1}{\Lambda}\right)_{sp}}{\frac{D_h}{D_{ha}} \cdot \left[\left(\frac{1}{\Lambda}\right)_w + \frac{1}{\alpha_a}\right]} \cdot (t_c - t_u) + t_c, \text{ in } ^\circ\text{C} \quad (\text{A.1})$$

Equation (A.2) may be used for a naturally ventilated space x with at least 40 mm to combustible materials. Take the corresponding value for the maximum temperature class allowed in Table A.2.

$$t_{calc} = \frac{\frac{1}{\alpha_i} + \left(\frac{1}{\Lambda}\right)}{\frac{D_h}{D_{ha}} \cdot \alpha_a} \cdot (t_a - t_u) + t_a, \text{ in } ^\circ\text{C} \quad (\text{A.2})$$

where

t_{calc}	is the calculated flue gas temperature	in °C;
α_i	is the internal coefficient of heat transfer	in W/(m²K);
α_a	is the external coefficient of heat transfer	in W/(m²K);
$(1/\Lambda)$	is the thermal resistance of the chimney or connecting flue pipe	in m²K/W;
$(1/\Lambda)_{sp}$	is the thermal resistance of the space between chimney or connecting flue pipe and adjacent combustible materials	in m²K/W;
$(1/\Lambda)_w$	is the thermal resistance of the adjacent wall with a combustible inner surface	in m²K/W;
D_{ha}	is the outer diameter of the chimney or the connecting flue pipe	in m;
D_h	is the inner diameter of the chimney (liner) or the connecting flue pipe	in m;
t_c	is the combustible surface temperature	in °C;
t_u	is the ambient temperature	in °C;
t_a	is the temperature at the outer surface of the chimney or connecting flue pipe	in °C.

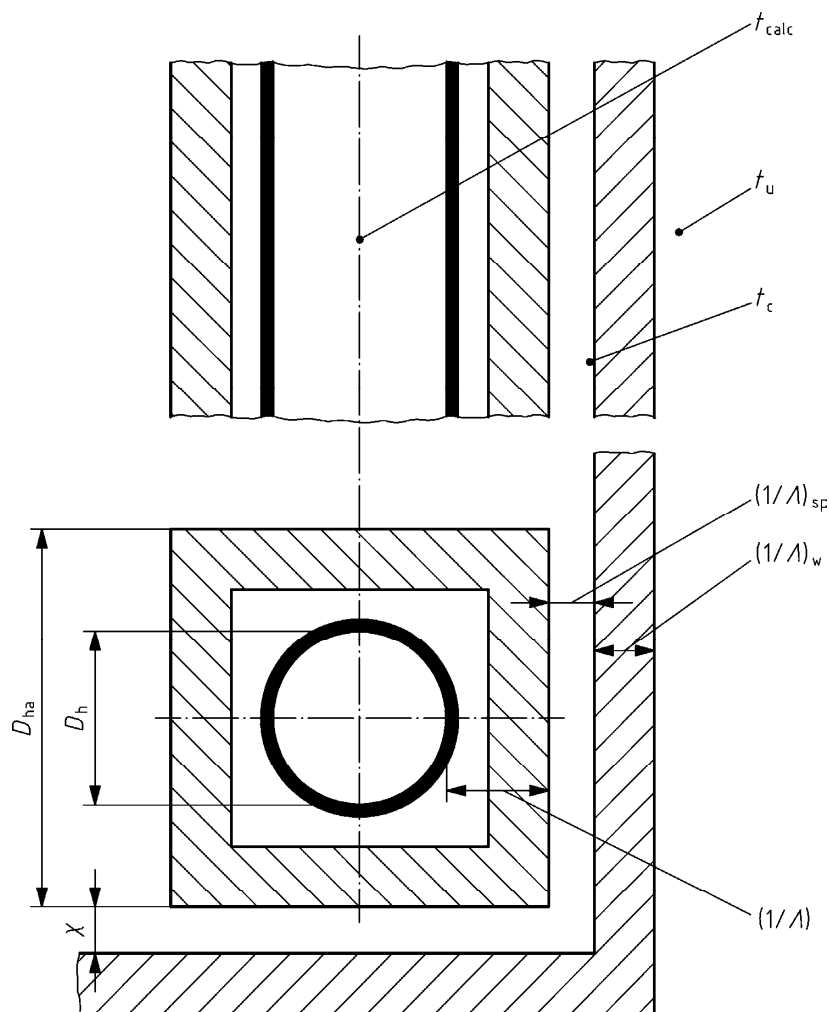


Figure A.1 — Example of calculation parameters

The thermal resistance of the chimney shall be calculated with Equation (A.3):

$$\left(\frac{1}{\Lambda}\right) = y \cdot \sum_n \left[\frac{D_h}{2 \cdot \lambda_n} \cdot \ln \left(\frac{D_{h,n} + 2 \cdot d_n}{D_{h,n}} \right) \right] \text{ in } \frac{\text{m}^2 \cdot \text{K}}{\text{W}} \quad (\text{A.3})$$

or where thermal resistance of the individual walls are known with Equation (A.4):

$$\left(\frac{1}{\Lambda}\right) = D_h \cdot \sum_n \left[\left(\frac{1}{\Lambda}\right)_n \cdot \frac{1}{D_{h,n}} \right] \text{ in } \frac{\text{m}^2 \cdot \text{K}}{\text{W}} \quad (\text{A.4})$$

where

$(1/\Lambda)$ is the thermal resistance of the chimney or the connecting flue pipe

in $\text{m}^2 \cdot \text{K}/\text{W}$;

$(1/\Lambda)_n$ is the thermal resistance of the individual wall n

in $\text{m}^2 \cdot \text{K}/\text{W}$;

y	is the coefficient of form: = 1,0 for round and oval cross-sections; = 1,10 for square and rectangular cross-sections up to a ratio of a side of 1:1,5;	
λ_n	is the coefficient of thermal conductivity of the material of the individual wall at its mean temperature (see Tables A.3, A.4 and A.5)	in W/(m·K);
D_h	is the inner diameter of the chimney (liner) or the connecting flue pipe	in m;
$D_{h,n}$	is the internal hydraulic diameter of the individual wall n	in m;
d_n	is the thickness of the individual wall	in m.

The influence of the thermal bridges for metal system chimneys should be taken into account by a factor described in EN 1859.

The thermal resistance of an individual wall may be determined using the following equation:

$$\left(\frac{1}{\Lambda}\right)_n = y \cdot \frac{D_{h,n}}{2 \cdot \lambda_n} \cdot \ln \left(\frac{D_{h,n} + 2 \cdot d_n}{D_{h,n}} \right) \text{ in m}^2 \cdot \text{K/W} \quad (\text{A.5})$$

where

$D_{h,n}$	is the internal hydraulic diameter of the individual wall	in m;
d_n	is the thickness of the individual wall	in m;
y	is the coefficient of form: = 1,0 for round and oval cross-sections; = 1,10 for square and rectangular cross-sections up to a ratio of a side of 1:1,5;	
λ_n	is the coefficient of thermal conductivity of the material of the individual wall at the operating mean temperature (see Tables A.4 and A.5)	in W/(m·K).

The influence of the thermal bridges for metal system chimneys should be taken into account by a factor described in EN 1859.

Table A.3 — Thermal resistance $(1/\lambda)_x$ in $\text{m}^2\text{K/W}$ for closed air gaps forming a concentric vertical annulus dependent on the width of the air gap x (see Figure A.1) and temperature at the inner surface of the air gap t_x

Temperature at the inner surface of the air gap	Width of the air gap				
	10 mm	20 mm	30 mm	40 mm	50 mm
40 °C	0,123	0,147	0,153	0,152	0,150
100 °C	0,087	0,101	0,101	0,100	0,099
150 °C	0,065	0,075	0,075	0,074	0,074
200 °C	0,050	0,055	0,055	0,055	0,054

NOTE For closed air gaps greater than 50 mm and temperatures higher than 200 °C a value of 0 is recommended in the absence of confirmed alternative data.

The values are calculated with the following equation:

For a width of air gaps from 0,01 to 0,05 m [A1] ($0,01 \text{ m} \leq x < 0,05 \text{ m}$) [A1] :

$$\left(\frac{1}{\Lambda}\right)_x = 0,1165 - 0,000488 \cdot t_x + 0,00000065 \cdot t_x^2 \quad \text{in } \text{m}^2\text{K/W} \quad (\text{A.6})$$

$$+ \left(4,36 - 0,0351 \cdot t_x + 0,000082 \cdot t_x^2\right) \cdot x - \left(58 - 0,46 \cdot t_x + 0,0011 \cdot t_x^2\right) \cdot x^2$$

The coefficient of heat conductivity λ_x of closed air gaps can be calculated using the following equation:

$$\lambda_x = y \cdot \frac{D_{h,x}}{2 \cdot \left(\frac{1}{\Lambda}\right)_x} \cdot \ln \left(\frac{D_{h,x} + 2 \cdot x}{D_{h,x}} \right) \quad \text{in } \text{W}/(\text{mK}) \quad (\text{A.7})$$

where

- $(1/\lambda)_x$ is the thermal resistance of the closed air gap in $\text{m}^2\text{K/W}$;
- t_x is the temperature at the inner surface of the air gap in °C;
- x is the width of the air gap in m;
- λ_x coefficient of thermal conductivity of the closed air gap in $\text{W}/(\text{m}\cdot\text{K})$;
- $D_{h,x}$ internal hydraulic diameter of the air gap in m;
- y coefficient of form:
 - = 1,0 for round and oval cross-sections;
 - = 1,10 for square and rectangular cross-sections up to a ratio of a side of 1:1,5.

The thermal resistance of the space between chimney or connecting flue pipe and adjacent combustible materials shall be taken from Table A.3 or calculated with Equation (A.8):

$$\left(\frac{1}{\Lambda}\right)_{sp} = 0,1165 - 0,000488 \cdot t_a + 0,00000065 \cdot t_a^2$$

$$+ (4,36 - 0,0351 \cdot t_a + 0,000082 \cdot t_a^2) \cdot x - (58 - 0,46 \cdot t_a + 0,0011 \cdot t_a^2) \cdot x^2$$

in $\frac{\text{m}^2 \cdot \text{K}}{\text{W}}$ (A.8)

Ⓐ for $0,01 \text{ m} \leq x < 0,05 \text{ m}$ Ⓐ.

where

$(1/\Lambda)_{sp}$ is the thermal resistance of the space between chimney or connecting flue pipe and adjacent combustible materials in $\text{m}^2\text{K/W}$;

y is the coefficient of form:
 = 1,0 for round and oval cross-sections;
 = 1,10 for square and rectangular cross-sections up to a ratio of a site of 1:1,5;

D_{ha} is the outer diameter of the chimney or the connecting flue pipe in m;

t_a is the temperature at the outer surface of the chimney or connecting flue pipe in °C;

x is the distance from the outer surface of the chimney or the connecting flue pipe to the surface of the combustible material (width of the air gap) in mm.

The following values shall be used:

for the inner diameters:

- equal or greater than 0,2 m: the actual diameter,
- less than 0,2 m: $D_h = 0,2 \text{ m}$.

For diameters less than 0,2 m the diameters of the individual walls n of the chimney shall be adjusted by the difference in the actual diameter and the 0,2 m specified value.

for the internal and external coefficient of heat transfer:

$$\alpha_i = 15 \text{ W}/(\text{m}^2\text{K}),$$

$$\alpha_a = 8 \text{ W}/(\text{m}^2\text{K})$$

and for the temperatures:

$$t_c = 85 \text{ °C},$$

$$t_u = 20 \text{ °C},$$

$$t_a = 100 \text{ °C for fire protection},$$

$$t_a \text{ for human contact where the chimney is not shielded against human contact see Table A.6.}$$

NOTE 1 t_{calc} is the calculated value dependent on the thermal resistance of the construction which gives the maximum allowed temperature to fulfil the requirements for the adjacent combustible material and/or for human contact (for examples of calculations see Ⓐ Annex I Ⓐ).

The thermal conductivity or resistance values of the individual walls shall either be those given by the product manufacturer or otherwise the default values of Tables A.4 to A.5 may be used.

Table A.4 — Thermal conductivity in W/(m·K) for insulation materials (EN 1443)

Material	20 °C	100 °C	200 °C	300 °C
Mineral wool, open	0,043	0,080	0,109	0,150
Mineral wool, ventilated	0,049	0,080	0,109	0,170
Mineral wool, plates	0,037	0,053	0,073	0,100
Mineral wool, shell	0,042	0,049	0,070	0,102
Vermiculite	0,062	0,076	0,096	0,126

NOTE 2 These default values include a safety factor of 1,2 to take account of manufacturing tolerances.

Table A.5 — Thermal conductivity in W/(m·K) for outer wall materials

Material	Mean temperature			
		20 °C	100 °C	200 °C
Bricks				
Bricks with full structure,	1 200 kg/m ³	0,60	0,63	0,66
vertically perforated bricks with	1 600 kg/m ³	0,82	0,86	0,90
closed structure,	2 000 kg/m ³	1,15	1,20	1,26
bricks for filling purposes				
Bricks	600 kg/m ³	0,40	0,44	0,50
Vertically perforated bricks with	800 kg/m ³	0,47	0,52	0,59
perforation degree A and B	1 000 kg/m ³	0,54	0,59	0,67
Concrete	800 kg/m ³	0,47	0,51	0,55
Light weight concrete with closed	1 200 kg/m ³	0,74	0,81	0,87
structure	1 600 kg/m ³	1,20	1,32	1,42
	2 000 kg/m ³	1,92	2,11	2,26
Concrete	800 kg/m ³	0,34	0,37	0,40
Light weight concrete with open	1 200 kg/m ³	0,55	0,60	0,65
structure	1 600 kg/m ³	0,90	0,97	1,06
	2 000 kg/m ³	1,44	1,55	1,70
Concrete	600 kg/m ³	0,22	0,24	0,27
Light weight concrete with open	900 kg/m ³	0,34	0,38	0,42
structure (natural basis)	1 200 kg/m ³	0,49	0,56	0,61
Concrete	600 kg/m ³	0,23	0,26	0,28
Light weight concrete with open	900 kg/m ³	0,36	0,40	0,45
structure, only expanded concrete	1 200 kg/m ³	0,53	0,58	0,66
	1 500 kg/m ³	0,72	0,80	0,89
Stainless steel		17	17	17

Where accidental human contact is possible, the maximum allowable outer surface temperatures of Table A.6. shall be used.

Member states without values in their own regulations in this aspect can choose the values.

Table A.6 — Maximum allowable outer surface temperatures where accidental human contact is possible

Material of the outer surface	Maximum allowed temperature
Metal – bare	70 °C
Metal – painted 50 µm	80 °C
Metal – Vitreous enamelled steel 160 µm	78 °C
Metal – plastic covered 400 µm	98 °C
Plastic	93 °C
Clay/ceramic, glass	85 °C
Concrete, marble	80 °C
NOTE The values in Table A.6 are based on the criteria in EN ISO 13732-1 relating to a 1 s burn threshold.	

The surface and mean temperatures of the individual walls shall be calculated iteratively till the estimated values are not less than the calculated values.

For the check that the estimated surface and mean temperatures of the individual walls are not too low the following equations can be used:

$$t_{m,n} = \frac{t_n + t_{n+1}}{2} \text{ in } ^\circ\text{C} \quad (\text{A.9})$$

with

$$t_1 = t_{\text{calc}} - \frac{\frac{1}{\alpha_i}}{\frac{1}{\alpha_i} + \left(\frac{1}{\Lambda}\right) + \frac{D_h}{D_{ha}} \cdot \left[\left(\frac{1}{\Lambda}\right)_{\text{sp}} + \left(\frac{1}{\Lambda}\right)_{\text{w}} + \frac{1}{\alpha_a} \right]} \cdot (t_{\text{calc}} - t_u) \text{ in } ^\circ\text{C} \quad (\text{A.10})$$

and

$$t_{n+1} = t_n - \frac{y \cdot \frac{D_h}{2 \cdot \lambda_n} \cdot \ln \left(\frac{D_{h,n} + 2 \cdot d_n}{D_{h,n}} \right)}{\frac{1}{\alpha_i} + \left(\frac{1}{\Lambda}\right) + \frac{D_h}{D_{ha}} \cdot \left[\left(\frac{1}{\Lambda}\right)_{\text{sp}} + \left(\frac{1}{\Lambda}\right)_{\text{w}} + \frac{1}{\alpha_a} \right]} \cdot (t_{\text{calc}} - t_u) \text{ in } ^\circ\text{C} \quad (\text{A.11})$$

or where thermal resistance of the individual walls are known with:

$$t_{n+1} = t_n - \frac{\frac{D_h}{D_{h,n}} \cdot \left(\frac{1}{\Lambda}\right)_n}{\frac{1}{\alpha_i} + \left(\frac{1}{\Lambda}\right) + \frac{D_h}{D_{ha}} \cdot \left[\left(\frac{1}{\Lambda}\right)_{sp} + \left(\frac{1}{\Lambda}\right)_w + \frac{1}{\alpha_a} \right]} \cdot (t_{calc} - t_u) \text{ in } ^\circ\text{C} \quad (\text{A.12})$$

where

$t_{m,n}$	is the mean temperature of the individual wall n	in $^\circ\text{C}$;
t_n	is the temperature at the inner surface of the individual wall n	in $^\circ\text{C}$;
t_{n+1}	is the temperature at the outer surface of the individual wall n	in $^\circ\text{C}$;
t_{calc}	is the calculated flue gas temperature	in $^\circ\text{C}$;
α_i	is the internal coefficient of heat transfer	in $\text{W}/(\text{m}^2\text{K})$;
$(1/\Lambda)$	is the thermal resistance of the chimney or connecting flue pipe	in $\text{m}^2\text{K}/\text{W}$;
D_h	is the inner diameter of the chimney (liner) or the connecting flue pipe	in m;
D_{ha}	is the outer diameter of the chimney or the connecting flue pipe	in m;
$(1/\Lambda)_{sp}$	is the thermal resistance of the space between chimney or connecting flue pipe and adjacent combustible materials	in $\text{m}^2\text{K}/\text{W}$;
$(1/\Lambda)_w$	is the thermal resistance of the adjacent wall with a combustible inner surface	in $\text{m}^2\text{K}/\text{W}$;
α_a	is the external coefficient of heat transfer	in $\text{W}/(\text{m}^2\text{K})$;
t_u	is the ambient temperature	in $^\circ\text{C}$;
y	is the coefficient of form: = 1,0 for round and oval cross-sections; = 1,10 for square and rectangular cross-sections up to a ratio of a side of 1:1,5;	
λ_j	is the coefficient of thermal conductivity of the material of the individual wall j at its mean temperature	in $\text{W}/(\text{m}\cdot\text{K})$;
$D_{h,j}$	is the internal hydraulic diameter of the individual wall j	in m;
d_n	is the thickness of the individual wall	in m;
$(1/\Lambda)_j$	is the thermal resistance of the individual wall j	in $\text{m}^2\text{K}/\text{W}$.

For calculation with Equation (A.2) is $\left(\frac{1}{\Lambda}\right)_{sp} = 0$ and $\left(\frac{1}{\Lambda}\right)_w = 0$.

A.4 Pressure class

The chimney shall be designated with the pressure class of the flue liner including any seals and jointed according to the manufacturer instructions otherwise the chimney shall be designated either N1 or N2, dependent on the flue liner or fitting which has the lesser designation.

A.5 Resistance to condensate class

The chimney shall be designated with the condensate resistance class of the flue liner including any seals, and jointed according to the manufacturer instructions otherwise the chimney shall be designated D.

A.6 Corrosion resistance class

The installed chimney shall be designated with the corrosion resistance class of the liner product except for metal chimneys.

The installed metal chimney shall have the corrosion resistance class 1 where the metal liner designation according to EN 1856-2 is V1, or corrosion resistance class 2 where it is V2, or 3 where it is V3. Where the flue liner is designated Vm the chimney shall be designated 1, 2, or 3 according to national regulations prevailing for the material comprising the flue liner.

NOTE The materials of the flue liner included in the designation according to EN 1856-2 may be the subject of national regulation with respect to the corrosion load in the chimney (the combination of condensate resistance and corrosion resistance) and designers are advised to check local regulations with regard to allowed materials having the appropriate specification (material type and thickness). Informative Annex E lists the correlation between the flue liner material specification and corrosion load claimed to exist in the various member states at the time of publication of the standard.

A.7 Sootfire resistance class

A chimney may be designated sootfire resistant "G" if:

- liner is designated as sootfire resistant and
- insulation that is declared from the liner manufacturer suitable for use in sootfire applications, or insulation which is declared by the insulation manufacturer as usable for a temperature of at least 900 °C and
- outer wall is to EN 12446, designated at least T400 and G or EN 13069 designated T600 (and passed the thermal shock test) or chimney products to EN 1806 and 1858 designated at least T400 and G or the outer wall is made according Table A.7 and
- any jointing material is suitable for sootfire resistant applications.

Other chimneys shall be designated "O".

NOTE Heating appliances burning soot producing fuels e.g. solid fuel need a "G" designated chimney.

Table A.7 — Materials for outer walls for sootfire resistance chimneys not tested for distance to combustible material

Classes	Standard	Minimum temperature class	Minimum wall thickness without test
Bricks	EN 771-1	T400	115 mm
Sand stone	EN 771-2	T400	115 mm
Clay outer wall elements	EN 13069	T 600	