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Free-standing chimneys - Part 1: General requirements

Freistehende Schornsteine - Teil 1: Allgemeine Anforderungen

Cheminées autoportantes - Partie 1 : Exigences générales

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Free-standing chimneys - Part 1: General requirements

Cheminées autoportantes - Partie 1 : Exigences générales

Freistehende Schornsteine - Teil 1: Allgemeine Anforderungen

This European Standard was approved by CEN on 23 December 2006.

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Foreword

This document (EN 13084-1:2007) has been prepared by Technical Committee CEN/TC 297 “Free- standing industrial chimneys”, the secretariat of which is held by DIN.

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of an identical text or by endorsement, at the latest by August 2007, and conflicting national standards shall be withdrawn at the latest by August 2007.

This document supersedes EN 13084-1:2000

This document is part 1 of a package of standards as listed below.

— EN 13084-1, *Free-standing chimneys - Part 1: General requirements*

— EN 13084-2, *Free-standing chimneys - Part 2: Concrete chimneys*

— EN 13084-4, *Free-standing chimneys - Part 4: Brick liners – Design and execution*

— EN 13084-5, *Free-standing chimneys - Part 5: Material for brick liners - Product specifications*

— EN 13084-6, *Free-standing chimneys - Part 6: Steel liners - Design and execution*

— EN 13084-7, *Free-standing chimneys – Part 7: Product specifications of cylindrical steel fabrications for use in single wall steel chimneys and steel liners*

— EN 13084-8, *Free-standing chimneys – Part 8: Design and execution of mast construction with satellite components*

Additionally applies:

— EN 1993-3-2, *Eurocode 3 - Design of steel structures – Part 3-2: Towers, masts and chimneys – Chimneys*

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, 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.

1 Scope

This European Standard deals with the general requirements and the basic performance criteria for the design and construction of all types of free-standing chimneys including their liners. A chimney may also be considered as free-standing, if it is guyed or laterally supported or if it stands on another structure.

Chimneys attached to buildings have to be structurally designed as free-standing chimneys in accordance with this European Standard when at least one of the following criteria is met:

— the distance between the lateral supports is more than 4 m;

— the free-standing height above the uppermost structural attachment is more than 3 m;

— the free-standing height above the uppermost structural attachment for chimneys with rectangular cross section is more than five times the smallest external dimension;

— the horizontal distance between the building and the outer surface of the chimney is more than 1 m.

Chimneys attached to free-standing masts are considered as free-standing chimneys.

The structural design of free-standing chimneys takes into account operational conditions and other actions to verify mechanical resistance and stability and safety in use. Detailed requirements relating to specialized designs are given in the standards for concrete chimneys, steel chimneys and liners.

NOTE In other parts of the series EN 13084 rules will be given where chimney products in accordance with EN 1443 (and the relating product standards) may be used in free-standing chimneys.

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 287-1, *Qualification test of welders - Fusion welding - Part 1: Steels*

EN 1418, *Welding personnel - Approval testing of welding operators for fusion welding and resistance weld setters for fully mechanized and automatic welding of metallic materials*

EN 1443, *Chimneys - General requirements*

EN 13084-2, *Free-standing chimneys – Part 2: Concrete chimneys*

EN 13084-4, *Free-standing chimneys – Part 4: Brick liners – Design and execution*

EN 13084-5, *Free-standing chimneys – Part 5: Materials for brick liners - Product specifications*

EN 13084-6, *Free-standing chimneys – Part 6: Steel liners - Design and execution*

EN 13084-7, *Free-standing chimneys – Part 7: Product specifications of cylindrical steel fabrications for use in single wall steel chimneys and steel liners*

EN 13084-8, *Free-standing chimneys – Part 8: Design and execution of mast construction with satellite components*

EN 1990, *Eurocode – Basis of structural design*

EN 1991-1-1, *Eurocode 1: Actions on structures - Part 1-1: General actions - Densities, self-weight, imposed loads for buildings*

EN 1991-1-4:2005, *Eurocode 1: Actions on structures - Part 1-4: General actions - Wind actions*

EN 1993-3-2, *Eurocode 3 - Design of steel structures - Part 3-2: Towers, masts and chimneys - Chimneys*

EN 1998-6, *Eurocode 8: Design of structures for earthquake resistance - Part 6: Towers, masts and chimneys*

EN ISO 3834-2, *Quality requirements for fusion welding of metallic materials - Part 2: Comprehensive quality requirements (ISO 3834-2:2005)*

EN ISO 14731, *Welding co-ordination - Tasks and responsibilities (ISO 14731:2006)*

EN ISO 15607, *Specification and qualification of welding procedures for metallic materials - General rules (ISO 15607:2003)*

EN ISO 15609-1, *Specification and qualification of welding procedures for metallic materials - Welding procedure specification - Part 1: Arc welding (ISO 15609-1:2004)*

EN ISO 15610, *Specification and qualification of welding procedures for metallic materials - Qualification based on tested welding consumables (ISO 15610:2003)*

EN ISO 15611, *Specification and qualification of welding procedures for metallic materials - Qualification based on previous welding experience (ISO 15611:2003)*

EN ISO 15612, *Specification and qualification of welding procedures for metallic materials - Qualification by adoption of a standard welding procedure (ISO 15612:2004)*

EN ISO 15613, *Specification and qualification of welding procedures for metallic materials - Qualification based on pre-production welding test (ISO 15613:2004)*

EN ISO 15614-1, *Specification and qualification of welding procedures for metallic materials - Welding procedure test - Part 1: Arc and gas welding of steels and arc welding of nickel and nickel alloys (ISO 15614-1:2004)*

EN ISO 15614-2, *Specification and qualification of welding procedures for metallic materials - Welding procedure test - Part 2: Arc welding of aluminium and its alloys (ISO 15614-2:2005)*

3 Terms and definitions

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

3.1
windshield
structural shell designed for load bearing purposes and to protect the flue from wind actions

NOTE It may also function as a flue.

3.2
lining system
total system, if any, which separates the flue gases from the windshield. This comprises a liner and its supports, the space between liner and windshield and insulation, where existing

3.3
liner
structural membrane of the lining system

3.4
accessible space
space between windshield and liner that is designed for entry by personnel

3.5
spoiler
device attached to the surface of a chimney with the objective of reducing cross wind response

3.6
protective cap
cap at the top of the chimney which covers the space between windshield and liner

3.7
climbing sockets
threaded sockets inserted in the concrete windshield to enable climbing dogs to be attached to the surface

3.8
down draught
negative pressure on the lee-side of the chimney top, which can cause the flue gases to be drawn down

3.9
guyed chimney
chimney, the stability of which is ensured by guy ropes

3.10
intransient heat flow
flow of heat, where the temperature of each point does not change with time

3.11
transient heat flow
flow of heat, where the temperature changes with time

3.12
positive pressure
pressure inside the liner which is greater than the pressure outside the liner

3.13
negative pressure
pressure inside the liner which is lower than the pressure outside the liner

3.14
flue gas
gaseous products of combustion or other processes, including air, which may comprise of solids or liquids

3.15
concrete chimney
chimney, the windshield of which is made of concrete

3.16
steel chimney
chimney, the windshield of which is made of steel

4 Performance requirements; general design

4.1 Materials

Materials shall conform to the appropriate CEN or ISO standards. Where no such standards exist, other materials may be used if their properties are well defined and their suitability has been proven. This proof shall take account of the mechanical, thermal and chemical loads.

For concrete and steel chimneys as well as for liners see EN 13084-2, EN 13084-4, EN 13084-5, EN 13084-6, EN 13084-7, EN 13084-8 and EN 1993-3-2.

4.2 Flue gas considerations

4.2.1 General

Thermal and flow calculations shall be carried out to ensure that the flue gases will be conveyed from the combustion appliance to atmosphere taking into account the effects of the flue gases on the environment and the safety in use. However, the effect of the flue gases concerning the pollution with gaseous and particle components is not the subject matter of this standard.

To carry out these calculations, design parameters as stated in 4.2.2 are required. These also apply to the assessment of chemical attack on those structural elements which are in contact with flue gases.

4.2.2 Design parameters

The following design parameters shall take into account the various operating conditions during normal and defined abnormal operations:

a) nature of chimney operation, whether continuous, intermittent or occasional;

b) planned frequency of shut-downs for internal inspection and maintenance;

c) composition of the flue gases and concentrations of chemicals in the flue gases deleterious for the chimney;

d) concentration of dust and particularly of abrasive dust in the flue gas;

e) mass flow of each flue gas stream;

f) flue gas temperature at entry of each flue gas duct into chimney;

g) range of maximum acid dew point temperatures of the flue gases;

h) admissible or required pressure at entry of flue gas ducts into chimney;

i) altitude of the site and any special local topographic features (e.g. nearby hills, cliffs);

j) maximum, average and minimum outside temperature;

k) maximum, average and minimum atmospheric pressure;

l) maximum, average and minimum humidity of the ambient air;

m) relevant design parameters used for appliances (for example boiler) to which the chimney is connected.

4.2.3 Heat flow calculations

Temperatures in the flue gas carrying tube, in thermal insulating layers and in the windshield shall be determined. The drop in the temperature of the flue gases as they pass up to the outlet shall be calculated.

Values for thermal conductivity and the heat transfer coefficient may be taken from Table 1 and Table 2 respectively. Values for materials not included in these tables or values differing from these, may be taken if their source is referenced.

Table 1 — Thermal conductivities for building materials

Material	Description	Bulk density ρ kg/m^3	Temperature T °C	Thermal conductivity λ W/(m·K)
Concrete		2400		2,1
Lightweight concrete		1000 1200 1400 1600 1800 2000		0,47 0,59 0,72 0,87 0,99 1,20
Brickwork		1800 2000 2200		0,81 0,96 1,00
Acid resistant brickwork				1,2
Brickwork of diatomaceous clay		800 800 800 500 [a] 500 [a] 500 [a]	200 400 600 200 400 600	0,18 0,19 0,21 0,09 0,10 0,11
Cellular glass		130	20 200 300	0,05 0,09 0,12
Mineral wool resistant up to 750 °C		90	50 100 150 200 250 300 400 500 600	0,038 0,045 0,053 0,064 0,076 0,090 0,122 0,168 0,230
		125	50 100 150 200 250 300 400 500 600	0,039 0,046 0,053 0,061 0,070 0,080 0,105 0,140 0,180
Structural steel and weather resistant structural steel		7850		60
Stainless steel	X5CrNi18-10 X6CrNiTi18-10 X6CrNiMoTi17-12-2 X2CrNiMo17-12-2 X2CrNiMo18-14-3 X1NiCrMoCu25-20-5	7900 7900 7980 7950 7980 8000		15 15 15 14 15 14

NOTE Where no values for bulk density and temperature are given, the thermal conductivity λ may be assumed as independent of these values.

a Shall only be used as insulation.

Table 2 — Heat transfer coefficients[a]

Zone	Heat transfer coefficient α $W/(m^2 \cdot K)$
Inner surface of the liner	$8 + w$ [b]
In case of accessible space between windshield and liner: — outer surface of the liner — inner surface of the windshield	 8 8
In case of non-accessible space between windshield and liner: — outer surface of the liner: — temperature > 80 °C; — temperature ≤ 80 °C — inner surface of the windshield	 20 12 8
Outer surface of the windshield	24 [c]

[a] These values are approximate values which lead to sufficiently accurate results for flue gas carrying tubes with an interior diameter of more than 1 m.

[b] w is the mean flue gas velocity in m/s. A detailed calculation of α is given in Annex A.

[c] For verification of the suitability of the materials as regards temperature a value $\alpha = 6\ W/(m^2 \cdot K)$ shall be taken.

4.2.4 Flow calculations

Flow calculations shall include calculations of pressure conditions inside the flue gas carrying tube and of flow velocity. They have to take into account the density of the flue gases and of the ambient air as well as energy losses, such as directional losses, losses due to friction and due to the joints.

If flue gas can permeate through the liner, for example in a brickwork liner, no positive pressure is allowed during normal operation conditions.

NOTE The start up pressure is not a normal operating condition in accordance with this European Standard.

The calculation should be carried out in accordance with Annex A. In the case of chimneys with a height of less than 20 m, the calculation may be carried out in accordance with EN 13384-1, provided that the conditions given in that standard apply.

4.2.5 Chemical attack

Chemical attack of the structural elements in contact with flue gases can occur by condensation of different flue gases to acid, for example sulphuric or hydrochloric acid polluted by chlorides or fluorides. Depending on the nature and period of time of the attack the chemical effect is graded into:

1) low;
2) medium;
3) high;
4) very high.

The chemical attack of flue gases containing SO_3 is graded according to Table 3 depending on the period during which the temperature of the liner wall falls below the acid dew point. Periods during which the installation is out of service are to be disregarded when determining the operating hours.