SLOVENSKI STANDARD
SIST EN 13084-4:2004

01-april-2004

Prostostoječi dimniki - 4. del: Notranje zidane cevi - Projektiranje in izvedba

Free-standing chimneys - Part 4: Brick liners - Design and execution

Freistehende Schornsteine - Teil 4: Innenrohre aus Mauerwerk- Entwruf, Bemessung und Ausführung

Cheminées autoportantes - Partie 4: Conduits intérieurs en briques de terre cuite - Conception et mise en oeuvre cution

Ta slovenski standard je istoveten z: **EN 13084-4:2002**

ICS:

91.060.40	Dimniki, jaški, kanali	Chimneys, shafts, ducts

SIST EN 13084-4:2004 **en**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 13084-4

November 2002

ICS 91.060.40

English version

Free-standing chimneys - Part 4: Brick liners - Design and execution

Conduits de fumée individuels pour cheminées - Partie 4: Conduits intérieurs en brique - Conception et exécution cution

Freistehende Schornsteine - Teil 4: Innenrohre aus Mauerwerk- Entwruf, Bemessung und Ausführung

This European Standard was approved by CEN on 22 August 2002.

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 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 Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

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

Management Centre: rue de Stassart, 36 B-1050 Brussels

Ref. No. EN 13084-4:2002 E

Contents

Foreword

This document (EN 13084-4:2002) 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 May 2003, and conflicting national standards shall be withdrawn at the latest by May 2003.

In this European Standard the annexes A, B and D are normative and the annexes C, E, F, G and H are informative.

This European Standard "*Free-standing chimneys"* consists of the following Parts:

— *Part 1: General requirements.*

— *Part 2: Concrete chimneys.*

— *Part 4: Brick liners - Design and execution.*

— *Part 5: Materials for brick liners - Product specifications.*

— *Part 6: Steel liners - Design and execution.*

— *Part 7: Product specifications of cylindrical steel fabrications for use in single wall steel chimneys and steel liners.*

— *Part 8: Design and execution of mast construction with satellite components.*

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

1 Scope

This European Standard specifies special requirements and performance criteria for the design and construction of lining systems made of brickwork for free-standing industrial chimneys. Current European practice favours sectional liners and the statements of the standard are mainly devoted to such solutions but are also largely applicable to base supported independent and stayed liners. The differences in the design and construction of the two last types are covered by annex A. This European Standard identifies requirements to ensure mechanical resistance and stability of liners in accordance with the general requirements given in EN 13084-1.

Lining systems comprise some or all of the following:

— chimney liner including duct entry;

— insulation;

— liner support;

— space between liner and concrete windshield.

Gas flow calculations to determine liner sizes are covered by EN 13084-1.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text, and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 1052-1, *Methods of test for masonry — Part 1: Determination of compressive strength.*

EN 1052-2, *Methods of test for masonry — Part 2: Determination of flexural strength.*

EN 13084-1:2000, *Free-standing industrial chimneys — Part 1: General requirements.*

prEN 13084-5:1998, *Free-standing chimneys — Part 5: Materials for brick liners — Product specifications.*

3 Terms, definitions and symbols

3.1 Terms and definitions

For the purposes of this European Standard, the terms and definitions given in EN 13084-1 together the following apply.

3.1.1
base supported liner
liner which is supported vertically only at the liner base

3.1.2
independent liner
base supported liner which has no other horizontal support or restraint

3.1.3
stayed liner
base supported liner which has horizontal restraints

3.1.4
sectional liner
liner which is supported vertically at a number of elevations

3.1.5
liner support
components, such as corbels or platforms, that support individual sections of the liner

3.1.6
duct entry
section which introduces the flue gases to the chimney liner

3.1.7
brickwork
whole of the material used to form a brickwork liner including both bricks and mortars used in its construction, together with any reinforcement that may be provided

3.1.8
thermal gradient
temperature difference between outer and inner wall surface related to the thickness of the wall

3.1.9
thermal effect
stresses in the liner due to temperature differences

3.1.10
thermal shock
effect on the liner of rapid changes in flue gas temperature, giving stresses. This can typically occur due to uncontrolled shutdowns, a fire or sudden by-pass of an energy conservation or flue gas desulphurisation unit

3.1.11
compensator
any systems which allows the movement of the joint in any direction maintaining its gas tightness

3.2 Symbols

The main symbols used in this European Standard are given in Table 1.

Table 1 — Main symbols

Symbol	Denomination	Unit
Safety factor:		
γ	partial safety factor	-
Material properties:		
f	strength	N/mm^2
E	modulus of elasticity	N/mm^2
σ	stress	N/mm^2
α_T	coefficient of thermal expansion	K^{-1}
Actions:		
T	thermal effects	-
G	permanent actions	-
W	wind actions	-
E	seismic actions	-
a	acceleration	m/s^2
Dimensions:		
d	diameter	m
t	wall thickness	m
Subscripts:		
c	compression	-
t	tensile	-
y	yield	-
k	characteristic	-
M	material	-
u	ultimate	-

4 Material

4.1 General

The choice of material will depend upon the service required.

4.2 Brickwork

4.2.1 General

The type of brickwork used is largely determined by the resistance to chemical attack of the bricks and mortars. In addition, when thermal shocks are expected, brick types will be selected on the basis of their resistance to spalling and other mechanical damage caused by the same.

Brickwork covered by this European Standard consists of brick types in accordance with Table 1 of prEN 13084-5:1998 and mortar types in accordance with Table 2 of prEN 13084-5:1998.

4.2.2 Thermal effects

According to the requirements as specified in 5.2.3.4 of EN 13084-1:2000, the temperature effect on brickwork shall be considered particularly with regard to:

— limit temperature of the various components;

— thermal gradients through the brickwork components in steady and transient conditions;

— uniform temperature;

— expansion;

— thermal shock.

Calculations based on the maximum temperature of flue gas and the maximum expected ambient temperature shall show that all the materials are operating below their allowable temperatures.

Thermal gradients, if not limited, could cause cracks in liners especially in those made of bricks type B1, B2 and B3.

Thermal shock can cause spalling and cracks on bricks type B1, B2 and B3. It normally causes only shallow cracks but the thermal gradient may cause these to grow.

4.2.3 Classification and chemical attack

4.2.3.1 General

Depending on the degree of chemical attack given in Table 3 of EN 13084-1:2000, the following types of brickwork may be used for the construction of chimney liners:

— brickwork type A: resistant to "very high chemical attack";

— brickwork type B: resistant to "high chemical attack";

— brickwork type C: resistant to "medium chemical attack";

— brickwork type D: resistant to "low chemical attack";

— brickwork type E: not subject to "chemical attack".

Mortar type M3 based an Portland cement may be used only for types D and E.

NOTE For all brickwork types in the presence of alkalis with temperatures above 680 °C, bricks with a low true porosity (10 % maximum) are recommended.

4.2.3.2 Brickwork type A: resistant to "very high chemical attack"

This will normally consist of:

— bricks type B1;

— mortar type M1 (in the case of very high chemical attack due only to acids: mortar type M2).

If abnormal temperature deviations are expected the limit in service temperature of mortars type M1 shall be taken into account.

Brickwork type A using mortar type M1 can also withstand alkaline condensates.

4.2.3.3 Brickwork type B: resistant to "high chemical attack"

This will normally consist of:

— bricks type B2;

— mortar type M2.

The use of mortar type M2 allows its use up to 900 °C; if thermal shocks are expected the resistance to thermal cycling of the bricks will be a factor of major importance.

Brickwork type B is not resistant to alkaline condensates.

4.2.3.4 Brickwork type C: resistant to "medium chemical attack"

This will normally consist of:

— bricks type B3;

— mortar type M2.

The use of mortar type M2 allows its use up to 900 °C; if thermal shocks are expected the resistance to thermal cycling of the bricks will be a factor of major importance.

Brickwork type C is not resistant to alkaline condensates.

4.2.3.5 Brickwork type D: resistant to "low chemical attack"

This will normally consist of:

— bricks type B4;

— mortar type M3.

4.2.3.6 Brickwork type E: not subjected to chemical attack

This will normally consist of:

— bricks type B4 or B5;

— mortar type M3.

Brickwork type E may be used in liners that are always operating safely above the dew point.

Bricks type B5 may only be used provided that mechanical actions such as erosion or abrasion are not expected.

4.3 Insulation

Insulation may be used to reduce the thermal gradient in the liner as well as in the windshield and to reduce the heat loss of the flue gases.

The following types of insulating materials are widely available for the purpose:

— insulating bricks;

— mineral wool blankets;

— cellular glass blocks;

— vermiculite/perlite preformed blocks;

— calcium silicate blocks;

— glass wool blankets;

— ceramic fibre lancets.

Stability of insulation shall be ensured even in the case of vibrations due to possible pulsation of flue gas pressure.

5 General design requirements

5.1 General

A gas tight floor shall be provided no more than 1,00 m from the bottom of the lowest duct entry.

Adequate means shall be provided to drain acid condensate to a safe location.

5.2 Minimum wall thickness

For the determination of the minimum wall thickness of the liner see Table 2.

5.3 Liner supports

Brickwork liner supports shall be designed with adequate rigidity to avoid imposing unacceptable non-uniform support reactions on the liner. In addition, in the case of multiflue chimneys, the deformation of the supporting platforms shall be such that the required clearance between the top of the liner and the upper platform is respected. Supports comprising segmental beams, supported by discrete corbels projecting from the windshield, shall be provided with torsional continuity by in-situ reinforced concrete joints or other means.

5.4 Openings

In order to limit the effects of differential temperatures around the circumference of the liner, openings introducing gases at different temperatures should be so arranged that a good mixing of the separate gas streams is ensured. They should be positioned at elevations as near to each other as possible in order to increase mixing between gas streams and reduce temperature differences which can otherwise cause additional stresses in the brickwork. See also annex B.

Table 2 — Minimum wall thickness for brickwork liners

	1	2	3	4
	Internal diameter, *d*, of liner In m	Minimum wall thickness, in mm, for		
		bricks without tongue and groove	shaped bricks with lateral tongue and groove	shaped bricks with continuous tongue and groove
1	$0 < d \leq 4{,}0$	115	100	64
2	$4{,}0 < d \leq 6{,}0$	115	100	80
3	$6{,}0 < d \leq 8{,}0$	115	100	100
4	$8{,}0 < d \leq 10{,}0$	—	120	120
5	$10{,}0 < d \leq 12{,}0$	—	140	140

5.5 Ventilation

Brickwork liners are normally used when flue gas pressure is lower than the ambient pressure outside the brickwork at the same elevation. Overpressure excursion of limited duration are permitted, but these should be taken into account in assessing the chemical load.

If the gas flow calculations show that significant operating periods are expected with flue gas pressure higher than the pressure in the space between liner and windshield, pressurisation of the space – by the use of fans – and the provision of compensators are required.

Where access is required into the space between liner and windshield during operation of a liner, ventilation shall be sufficient to ensure that no flue gas leaks through the liner. The ventilation system shall comply with the requirements of 4.5 of EN 13084-1:2000.

Air ventilation can also be used to cool and avoid significant thermal stresses within the liner supports.

5.6 Protective coatings

Concrete surfaces inside the windshield may be protected by a suitable chemical resistant coating or membrane, whose viability and long term integrity has been demonstrated in wet and dry conditions of exposure to flue gas at the anticipated operating temperatures.

An acid resistant coating shall be applied to all parts of the support system that are not easily accessible for regular inspection and maintenance. In addition, an acid resistant membrane shall be provided between the support and the supported brickwork. This membrane may be of lead or a chemical resistant coating.

In the case of a accessable space the interior surface of the windshield requires protection particularly if significant periods of operation characterised by flue gas overpressure are expected.

Horizontal surfaces of structures for inspection or support (slabs, beams etc.) shall be provided with a condensates draining system when the formation of aggressive condensate is expected.