



SLOVENSKI STANDARD

SIST EN 13084-5:2005

01-november-2005

Free-standing chimneys - Part 5: Material for brick liners - Product specifications

Freistehende Schornsteine - Baustoffe für Innenrohre aus Mauerwerk - Teil 5: Produktfestlegungen

Cheminées autoportantes - Partie 5 : Matériaux pour conduits intérieurs en terre cuite - Spécification du produit

Ta slovenski standard je istoveten z: EN 13084-5:2005

ICS: 91.060.40 Dimniki, jaški, kanali Chimneys, shafts, ducts

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EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 13084-5

June 2005

ICS 91.060.40; 91.100.15

English Version

Free-standing chimneys - Part 5: Material for brick liners - Product specifications

Cheminées autoportantes - Partie 5 : Matériaux pour
conduits intérieurs en terre cuite - Spécification du produit

Freistehende Industrieschornsteine - Teil 5: Baustoffe für
Innenrohre aus Mauerwerk - Produktfestlegungen

This European Standard was approved by CEN on 17 December 2004.

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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 Central Secretariat has the same status as the official versions.

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Foreword

This document (EN 13084-5:2005) 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of an identical text or by endorsement, at the latest by December 2005, and conflicting national standards shall be withdrawn at the latest by March 2007.

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

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this document.

This European Standard is part 5 of the package of standards 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;
- prEN 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

- ENV 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, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

EN 13084-5:2005 (E)**1 Scope**

This European Standard specifies performance requirements and test methods for clay/ceramic bricks and factory made mortars used for the construction of brick liners in free-standing industrial chimneys. The structural design of the brick liners is specified in EN 13084-4.

The marking requirement for bricks and mortar covered by this European Standard is included.

This European Standard provides for the evaluation of conformity of material for brick liners to this EN.

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 197-1, *Cement – Part 1: Composition, specifications and conformity criteria for common cements*

EN 772-7, *Methods of test for masonry units – Part 7: Determination of water absorption of clay masonry damp proof course units by boiling in water*

EN 772-16, *Methods of test for masonry units – Part 16: Determination of dimensions*

EN 772-20, *Methods of test for masonry units – Part 20: Determination of flatness of faces of aggregate concrete, manufactured stone and natural stone masonry units*

EN 993-1, *Methods of test for dense shaped refractory products – Part 1: Determination of bulk density, apparent porosity and true porosity*

EN 993-5, *Methods of test for dense shaped refractory products – Part 5: Determination of cold crushing strength*

EN 993-6, *Methods of test for dense shaped refractory products – Part 6: Determination of modulus of rupture at ambient temperature*

CEN/TS 993-11, *Dense shaped refractory products – Part 11: Determination of resistance to thermal shock*

EN 993-16, *Dense shaped refractory products - Methods of test – Part 16: Determination of resistance to sulphuric acid*

EN 1015-10, *Methods of test for mortar for masonry – Part 10: Determination of dry bulk density of hardened mortar*

EN 1015-11, *Methods of test for mortar for masonry – Part 11: Determination of flexural and compressive strength of hardened mortar*

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 1052-3, *Methods of test for masonry – Part 3: Determination of initial shear strength*

EN 1443: 2003, *Chimneys – General requirements*

EN 13084-1:2000, *Free-standing chimneys – Part 1: General requirements*

EN 13084-4:2005, *Free-standing chimneys – Part 4: Brick liners – Design and execution*

EN 14297:2004, *Chimneys – Freeze-thaw resistance test method for chimney products*

ISO 3951, *Sampling procedures for inspection by variables – Part 1: Specification for single sampling plans indexed by acceptance quality limit (AQL) for lot-by-lot inspection for a single quality characteristic and a single AQL*

3 Terms and definitions

For the purposes of this European Standard, the terms and definitions of EN 13084-1:2000 and EN 13084-4:2005 apply.

4 Requirements for the liner

4.1 General

The liner is formed by brickwork using clay/ceramic bricks according to 5.1 and mortar according to 5.2. It shall be designed in accordance with EN 13084-4 and shall be erected according to the state of the art. Dependent on the brick and mortar types used the brickwork is classified in accordance with EN 13084-4: 2005, 4.2.3 (see also Table 1).

Table 1: Liner brickwork classes
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	Mortar types			Resistance to chemical attack	
	MT1	MT2	MT3		
Brick types	BT1	A ¹⁾		very high	
	BT2		B	high	
	BT3		C	medium	
	BT4			D	low
	BT5			E	no chemical attack
Resistance to chemical attack	very high	high	low		

¹⁾ only if the very high chemical attack is due only to acids

4.2 Performance characteristics

4.2.1 General

The characteristics specified in 4.2 presume an execution of the liner in accordance with EN 13084-4.

4.2.2 Mechanical resistance and stability

Mechanical resistance and stability shall be verified according to EN 13084-4 taking into account characteristic values of compressive and flexural strength for the different brickwork classes which are specified in EN 13084-4: 2005, Table 3 or are determined by tests in accordance with EN 1052-1 and EN 1052-2 respectively.

EN 13084-5:2005 (E)**4.2.3 Compressive strength**

In order to meet this requirement the bricks shall comply with the respective values given in Table 2 and the mortar with the values given in Table 4.

4.2.4 Flexural tensile strength

In order to meet this requirement the bricks shall comply with the respective values given in Table 2 and the mortar with the values for initial shear strength in accordance with Table 4.

4.2.5 Resistance to fire

Soot fire resistance shall only be verified for brick liners conveying flue gas of solid combustibles and whose inner diameter in the case of circular section or smallest inner lateral length in the case of rectangular section is less than 1,0 m.

In this case EN 1443: 2003, 6.3.2 applies.

For liners different from the above mentioned ones the verification of soot fire resistance may be omitted. This also applies to liners for chimneys with an upstream flue gas treatment.

Limit values of permissible temperatures for bricks and mortars shall be declared by the manufacturer.

4.2.6 Gas tightness

En 13084-1: 2000, 4.2.4 specifies that in a brickwork liner positive internal pressure shall only be allowed in a short-term or exceptional situation. It is not allowed during normal operation conditions. The state of the art has shown, that gas tightness may not be required.

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4.2.7 Flow resistance

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A mean roughness value for brickwork liners to carry out flow calculations is given in EN 13084-1: 2000, Table A.3.

4.2.8 Dimensioning/ Thermal resistance

Heat flow calculations shall be carried out according to EN 13084-1: 2000, 4.2.3. Thermal resistance shall be calculated according to EN 13084-1: 2000, A.2.2 using the values of thermal conductivity specified in EN 13084-1: 2000, Table 1.

4.2.9 Thermal shock resistance

This requirement is met by testing successfully the bricks and mortar for resistance to temperature change according to Table 2 and Table 4 respectively.

4.2.10 Resistance to freeze-thaw

Resistance to freeze-thaw shall only be required for bricks and mortar used in parts of the liner near the mouth of the chimney. The requirement is met by testing successfully the bricks according to 6.1.9. For mortar see 6.2.8.

4.2.11 Durability

Durability to chemical attack is verified by classifying brickwork (bricks and mortar) in accordance with EN 13084-4: 2005, 4.2.3 and Table 1 of this standard dependent on the degree of chemical attack (see also EN 13084-1: 2000, Table 3).

5 Materials

5.1 Bricks

5.1.1 General

Bricks may be of plain rectangular shape or they may be profiled to develop shear keys in the mortar, or to accept metal reinforcement.

The requirements for bricks are given in Table 2 and Table 3.

The surface of bricks should be free of cracks.

Smaller cracks (microcracks) shall not exceed the following values:

- Crack width $\leq 0,05$ mm;
- Crack length ≤ 10 mm;
- Crack depth ≤ 2 mm.

5.1.2 Bricks Type BT1

Bricks type BT1 are suitable for brickwork resistant to "very high chemical attack" due to acids and alkalis.

Attention shall be paid to their sensitivity to thermal shocks.

5.1.3 Bricks Type BT2 (a) and BT2 (b)

Bricks type BT2 (a) and BT2 (b) are suitable for brickwork resistant to "high chemical attack" in the presence of acids or alkalis.

The chemical resistance of bricks type BT2 (a) derives from the properties of their ingredients, whereas type BT2 (b) derives their chemical resistance mainly from their high density and low permeability.

When there is a risk of thermal shock, only bricks type BT2 (a) shall be used due to their resistance to spalling.

5.1.4 Bricks Type BT3

Bricks type BT3 are suitable for brickwork resistant to "medium chemical attack". They comprise dense bricks of burnt clay or shale.

5.1.5 Bricks Type BT4

Bricks type BT4 are used in brickwork subjected to high temperatures. They are suitable for brickwork at operating conditions not more severe than "low chemical attack". They comprise refractory bricks of fireclay.

5.1.6 Bricks Type BT5

Bricks type BT5 are characterized by a low thermal conductivity. They are suitable for brickwork not subjected to chemical attack. They comprise bricks of diatomaceous clay (such as Moler).

Table 2: Physical and chemical requirements for brick types

Property	Unit	Brick type						Test method see
		BT1	BT2		BT3	BT4	BT5	
			BT2 (a)	BT2 (b)				
Bulk density	t/m ³	≥ 2,0	≥ 2,0	≥ 2,40	≥ 2,0	≥ 1,8	≥ 0,7 ≤ 0,9	6.1.2
Compressive strength (Cold crushing strength)	N/mm ²	≥ 50	≥ 40	≥ 100	≥ 30	≥ 25	≥ 6	6.1.3
Flexural tensile strength	N/mm ²	≥ 5	≥ 4	≥ 10	≥ 3	≥ 2,5	≥ 0,7	6.1.4
Water absorption	%	≤ 6,0 ^a	≤ 8,0 ^a	≤ 2,50	≤ 10,0	≤ 10,0	-	6.1.5
Acid solubility	%	≤ 1,5	≤ 2,5	≤ 8,0	≤ 5,0	≤ 5,0	-	6.1.6
Resistance to temperature change	Number of Cycles	6	≥ 10	≥ 10	≥ 12	≥ 12	≥ 12	6.1.7

^a For tall liners, where irreversible expansion under conditions of "very high" and "high" chemical attack may be a problem, a lower limit may be appropriate.

Table 3: Tolerances of brick dimensions ^a

Dimension	Tolerance class				Test method see
	T1	T2			
	Brick type				
	All brick types	BT1, BT2	BT3, BT4	BT5	
Height	± 2,0 mm	≤ 133 mm: ± 2,0 mm ^b > 133 mm: ± 1,5 % ^b	≤ 100 mm: ± 2,0 mm > 100 mm: ± 2,0 %	≤ 80 mm: ± 2,0 mm > 80 mm: ± 2,5 %	6.1.8
Length/Width	± 2,0 mm	≤ 100 mm: ± 2,0 mm ^c > 100 mm: ± 2,0 % ^c	≤ 100 mm: ± 2,0 mm ^c > 100 mm: ± 2,0 % ^c	≤ 80 mm: ± 2,0 mm ^c > 80 mm: ± 2,5 % ^c	
Difference between diagonals	± 2,0 mm	≤ 100 mm: ± 2,0 mm ^c > 100 mm: ± 2,0 % ^c	≤ 100 mm: ± 2,0 mm ^c > 100 mm: ± 2,0 % ^c	≤ 80 mm: ± 2,0 mm ^c > 80 mm: ± 2,5 % ^c	
Flatness: Concavity, convexity	± 2,0 mm	± 2,0 mm	± 2,0 mm	± 2,0 mm	
Tongue and groove	± 1,0 mm	± 1,0 mm	± 1,0 mm	—	
^a Tolerances have to be chosen taking into account the used mortar type. ^b To be applied to bricks manufactured by pressure moulding in a steel rectified mould and by means of a hydraulic press. For bricks manufactured in a wood mould and/or compacted by means of hand tools the following tolerances may be accepted: ≤ 100 mm ± 2 mm; > 100 mm ± 2 %. ^c To be applied to bricks manufactured by pressure moulding in a steel rectified mould and by means of a hydraulic press. For bricks manufactured in a wood mould and/or compacted by means of hand tools the following tolerances may be accepted: ≤ 70 mm ± 2 mm; > 70 mm ± 3 %.					

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Table 4: Requirements for mortar types

Property	Unit	Mortar type				Test method see
		MT1			MT2	
		Epoxy resin	Phenolic resin	Furan resin	Potassium silicate mortar	
Bulk density	t/m ³	≥ 2,0	≥ 1,4	≥ 1,6	1,9 – 2,1	6.2.2
Compressive strength	N/mm ²	≥ 50			≥ 20	6.2.3
Initial shear strength	N/mm ²	≥ 3,5			≥ 2,5	6.2.4
Water absorption	%	≤ 0,5			≤ 8 ^a	6.2.5
Acid solubility	%	≤ 0,2			≤ 2,0	6.2.6
Resistance to temperature change	Number of cycles	≥ 6			≥ 12	6.2.7

^a For tall liners, where irreversible growth under conditions of "high" chemical attack may be a problem, a lower limit may be appropriate.