



SLOVENSKI STANDARD
SIST EN 197-4:2004
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Cement - 1. del: Sestava, zahteve in merila skladnosti za žilindrine cemente z nizko zgodnjo trdnostjo

Cement - Part 4: Composition, specifications and conformity criteria for low early strength blastfurnace cements

Zement - Teil 4: Zusammensetzung, Anforderungen und Konformitätskriterien von Hochofenzement mit niedriger Anfangsfestigkeit

Ciment - Partie 4 : Composition, spécification et critères de conformité des ciments de haut fourneau et a faible résistance a court terme

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English version

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This European Standard was approved by CEN on 19 September 2003.

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 Central Secretariat 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 Central Secretariat has the same status as the official versions.

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Foreword

This document (EN 197-4:2004) has been prepared by Technical Committee CEN/TC 51 "Cement and building limes", the secretariat of which is held by IBN.

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of an identical text or by endorsement, at the latest by October 2004, and conflicting national standards shall be withdrawn at the latest by October 2004.

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.

Annex A is informative.

This document includes a Bibliography.

The various stages in the development of a European Standard for common cement, in response to the preliminary Mandate given to CEN by the EC and the EFTA, are described in EN 197-1. It is indicated that, in view of the large numbers of different cements involved, it was considered necessary to separate the "common cements", which are now covered by EN 197-1, from special cements i.e. those with additional or special properties or those having hardening processes not mainly dependent on the hydration of calcium silicates.

The strength attained at 28 days is the important criterion in classifying cement for most uses. In order to achieve a specific strength class at 28 days the early strength, at 2 days or at 7 days, can vary and some types of cement may not attain the minimum early strengths specified in EN 197-1 for common cements. The heat of hydration is linked to the early reactivity and lower early strengths indicate lower heat evolution and lower temperatures in concrete. For these cements additional precautions in use can be necessary to ensure adequate curing and safety in construction. The purpose of this EN 197-4 is to specify the composition requirements and conformity requirements for low early strength blastfurnace cements and low early strength blastfurnace cements with low heat of hydration.

The requirements in EN 197-4 are based on the results of tests on cement in accordance with EN 196 Parts 1, 2, 3, 7, 8, 9 and 21. The scheme for the evaluation of conformity of low early strength blastfurnace cements to EN 197-4 is included in EN 197-2.

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 United Kingdom.

Introduction

It is recognised that different cements have different properties and performance. Those performance tests now available (i.e. setting time, strength, soundness and heat of hydration), have been included in this EN 197-4. In addition, work is being carried out by CEN/TC 51 to identify any additional tests which are needed to specify further performance characteristics of cement. Until further performance tests are available it is highly recommended that the choice of cement, especially the type and/or strength class in relation to the requirements for durability depending on exposure class and type of construction in which it is incorporated, follows the appropriate standards and/or regulations for concrete valid in the place of use.

1 Scope

This EN 197-4 defines and gives the specifications of 3 distinct low early strength blastfurnace cement products and their constituents. The definition of each cement includes the proportions in which the constituents are to be combined to produce these distinct products in a range of three strength classes. The definition also includes requirements the constituents have to meet and the mechanical, physical, chemical, including where appropriate, heat of hydration, requirements and strength classes. This EN 197-4 also states the conformity criteria and the related rules. Necessary durability requirements are also given.

NOTE 1 In addition to the specified requirements, an exchange of additional information between the cement producer and user can be helpful. The procedures for such an exchange are not within the scope of EN 197-4 but should be dealt with in accordance with national standards or regulations or can be agreed between the parties concerned.

NOTE 2 The word "cement" in this EN 197-4 is used to refer only to low early strength blastfurnace cements unless otherwise indicated.

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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 196-1, *Methods of testing cement — Part 1 : Determination of strength.*

EN 196-2, *Methods of testing cement — Part 2 : Chemical analysis of cement.*

EN 196-3, *Methods of testing cement — Part 3 : Determination of setting time and soundness.*

EN 196-7, *Methods of testing cement — Part 7 : Methods of taking and preparing samples of cement.*

EN 196-8, *Methods of testing cement — Part 8 : Determination of heat of hydration — Solution method.*

EN 196-9, *Methods of testing cement — Part 9 : Determination of heat of hydration — Semi-adiabatic method.*

EN 196-21¹⁾, *Methods of testing cement — Part 21 : Determination of the chloride, carbon dioxide and alkali content of cement.*

1) EN 196-21 is currently being incorporated into EN 196-2.

EN 197-1:2000, *Cement — Part 1 : Composition, specifications and conformity criteria for common cements.*

EN 197-1:2000/A1:2004, *Cement — Part 1 : Composition, specifications and conformity criteria for common cements.*

EN 197-2:2000, *Cement — Part 2 : Conformity evaluation.*

3 Terms and definitions

For the purposes of this European Standard, the terms and definitions given in EN 197-1:2000 and the following apply.

3.1

type of low early strength blastfurnace cement

one of the 3 products (see Table 1) in the family of low early strength cements

3.2

heat of hydration

quantity of heat developed by the hydration of a cement within a given period of time

3.3

low heat low early strength blastfurnace cement

low early strength blastfurnace cement with a limited heat of hydration

4 Low early strength blastfurnace cement

Low early strength blastfurnace cement is a hydraulic binder, i.e. a finely ground inorganic material which, when mixed with water, forms a paste which sets and hardens by means of hydration reactions and processes and which, after hardening, retains its strength and stability even under water. It has hydration reactions and processes identical to those of common cements (see EN 197-1) but through composition, fineness or reactivity of constituents the early hydration process is slower.

5 Constituents

For the purpose of this European Standard the requirements for constituents specified in clause 5 of EN 197-1:2000 apply.

6 Composition and notation

The 3 products in the family of low early strength blastfurnace cements, covered by this European Standard, and their notation are given in Table 1. They are grouped into one main cement type:

— CEM III Blastfurnace cement

The composition of the different low early strength blastfurnace cements shall be in accordance with Table 1.

NOTE For clarity in definition, the requirements for the composition refer to the sum of all main and minor additional constituents. The final cement should be understood as the main and minor additional constituents plus the necessary calcium sulfate (see 5.4 of EN 197-1:2000) and any additives (see 5.5 of EN 197-1:2000).

Table 1 — The 3 products in the family of low early strength blastfurnace cements

Main types	Notation of the 3 products (types of low early strength blastfurnace cements)		Composition (proportion by mass, in % ^a)		
			Main constituents		Minor additional constituents
			Clinker	Blastfurnace Slag	
			K	S	
CEM III	Blastfurnace cement	CEM III/A	35-64	36-65	0-5
		CEM III/B	20-34	66-80	0-5
		CEM III/C	5-19	81-95	0-5

^a The values in the table refer to the sum of the main and minor additional constituents.

7 Mechanical, physical, chemical and durability requirements

7.1 Mechanical requirements

7.1.1 Standard strength

The standard strength of cement is the compressive strength determined in accordance with EN 196-1 at 28 days and shall conform to the requirements in Table 2, which are identical to those in EN 197-1.

Three classes of standard strength, as defined in EN 197-1, are included; class 32,5, class 42,5 and class 52,5 (see Table 2).

7.1.2 Early strength

The early strength of cement is the compressive strength determined in accordance with EN 196-1 at either 2 days or 7 days and shall conform to the requirements in Table 2.

One class of early strength is included for each class of standard strength indicated by L (see Table 2).

NOTE The requirements for early strength class (L) for these cements are the only requirements that differ from those in EN 197-1.

Table 2 — Mechanical and physical requirements given as characteristic values

Strength class	Compressive strength MPa				Initial setting time min	Soundness (Expansion) mm
	Early strength		Standard strength			
	2 days	7 days	28 days			
32,5 L	—	≥ 12,0	≥ 32,5	≤ 52,5	≥ 75	≤ 10
42,5 L	—	≥ 16,0	≥ 42,5	≤ 62,5	≥ 60	
52,5 L	≥ 10,0	—	≥ 52,5	—	≥ 45	

7.2 Physical requirements

7.2.1 Initial setting time

The initial setting time, determined in accordance with EN 196-3, shall conform to the requirements in Table 2, which are identical to those in EN 197-1.

7.2.2 Soundness

The expansion, determined in accordance with EN 196-3, shall conform to the requirement in Table 2, which is identical to that in EN 197-1.

7.2.3 Heat of hydration

The heat of hydration of low heat low early strength blastfurnace cements shall not exceed the characteristic value of 270 J/g, determined in accordance with either EN 196-8 at 7 days or in accordance with EN 196-9 at 41 h and is identical to that in EN 197-1: 2000/A1:2004.

NOTE A pre-normative research project has demonstrated the equivalence of test results for EN 196-8 at 7 days and EN 196-9 at 41 h. Nevertheless, in case of dispute between laboratories, the method to be applied should be agreed.

Low heat low early strength blastfurnace cements are indicated by LH.

7.3 Chemical requirements

The properties of the cements of the cement type and strength class shown in columns 3 and 4 respectively of Table 3 shall conform to the requirements listed in column 5 of this table when tested in accordance with the standard referred to in column 2. These requirements are identical to those in EN 197-1 for the cement types CEM III.

NOTE Some European countries have regulations for the content of water-soluble hexavalent chromium (see informative annex A).

Table 3 — Chemical requirements given as characteristic values

1	2	3	4	5
Property	Test reference	Cement type	Strength class	Requirements ^a
Loss on ignition	EN 196-2	CEM III	all	≤ 5,0 %
Insoluble residue	EN 196-2 ^b	CEM III	all	≤ 5,0 %
Sulfate content (as SO ₃)	EN 196-2	CEM III ^c	all	≤ 4,0 %
Chloride content	EN 196-21	CEM III ^d	all	≤ 0,10 %

^a Requirements are given as percentage by mass of the final cement.

^b Determination of residue insoluble in hydrochloric acid and sodium carbonate.

^c Cement type CEM III/C may contain up to 4,5 % sulfate.

^d Cement type CEM III may contain more than 0,10 % chloride but in that case the maximum chloride content shall be stated on the packaging and/or the delivery note.

7.4 Durability requirements

In many applications, particularly in severe environmental conditions, the choice of cement has an influence on the durability of concrete, mortar and grouts, e. g. frost resistance, chemical resistance and protection of reinforcement.

The choice of cement, from this European Standard, particularly as regards type and class for different applications and exposure classes shall follow the appropriate standards and/or regulations for concrete or mortar valid in the place of use.

These cements will have lower early strength compared with a common cement of the same standard strength class and may require additional precautions in their use such as extension of formwork stripping times and protection during adverse weather. In all other respects their performance and suitability of application will be similar to those of common cements, conforming to EN 197-1, of the same type and standard strength class.

8 Standard designation

Low early strength blastfurnace cements shall be identified by at least the notation of the cement type as specified in clause 6 and the figures 32,5, 42,5, or 52,5 indicating the strength class (see 7.1). In order to indicate the low early strength the letter L shall be added (see 7.1). For cements having a low heat of hydration this shall be indicated by adding the letters LH (see 7.2.3).

EXAMPLE 1 Blastfurnace cement with a granulated blastfurnace slag (S) content between 66 % and 80 %, a strength class 32,5 and low early strength is identified by:

Low early strength blastfurnace cement EN 197-4 – CEM III/B 32,5 L.

EXAMPLE 2 Blastfurnace cement with a granulated blastfurnace slag (S) content between 81 % and 95 %, a strength class 32,5, low early strength and low heat of hydration is identified by:

Low early strength low heat blastfurnace cement EN 197-4 – CEM III/C 32,5 L - LH.

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9 Conformity criteria

9.1 General requirements

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Conformity of the 3 products to this European Standard shall be continually evaluated on the basis of testing of spot samples. The properties, test methods and the minimum testing frequencies for the autocontrol testing by the manufacturer are specified in Table 4. Concerning testing frequencies for cement not being dispatched continuously and other details, see EN 197-2.

For certification of conformity by an approved certification body, conformity of cement with this European Standard shall be evaluated in accordance with the scheme specified in EN 197-2.

NOTE This European Standard does not deal with acceptance inspection at delivery.

Table 4 — Properties and test methods and minimum testing frequencies for the autocontrol testing by the manufacturer and the statistical assessment procedure

Property	Cements to be tested	Test method ^{a b}	Autocontrol testing			
			Minimum testing frequency		Statistical assessment procedure	
			Routine situation	Initial period for a new type of cement	Inspection by	
					Variables ^e	Attributes
1	2	3	4	5	6	7
Early strength Standard strength	All	EN 196-1	2/week	4/week	x	
Initial setting time	All	EN 196-3	2/week	4/week		x ^f
Soundness (expansion)	All	EN 196-3	1/week	4/week		x
Loss on ignition	All	EN 196-2	2/month ^c	1/week		x ^f
Insoluble residue	All	EN 196-2	2/month ^c	1/week		x ^f
Sulfate content	All	EN 196-2	2/week	4/week		x ^f
Chloride content	All	EN 196-21	2/month ^c	1/week		x ^f
Heat of hydration	Low heat cements	EN 196-8 or EN 196-9	1/month	1/week		x ^f
Composition	All	— ^d	1/month	1/week		

^a Where allowed in the relevant part of EN 196, other methods than those indicated may be used providing they give results equivalent to those obtained with the reference method.

^b The methods used to take and prepare samples shall be in accordance with EN 196-7.

^c When none of the test results within a period of 12 months exceeds 50 % of the characteristic value the frequency may be reduced to one per month.

^d Appropriate test method chosen by the manufacturer.

^e If the data are not normally distributed then the method of assessment may be decided on a case by case basis.

^f If the number of samples is at least one per week during the control period, the assessment may be made by variables.

9.2 Conformity criteria for mechanical, physical and chemical properties and evaluation procedure

9.2.1 General

Conformity of cement to the requirements for mechanical, physical and chemical properties in this European Standard is assumed if the conformity criteria specified in 9.2.2 and 9.2.3 are met. Conformity shall be evaluated on the basis of continual sampling using spot samples taken at the point of release and on the basis of the test results obtained on all autocontrol samples taken during the control period.

9.2.2 Statistical conformity criteria

9.2.2.1 General

Conformity shall be formulated in terms of a statistical criterion based on:

- the specified characteristic values for mechanical, physical and chemical properties as given in 7.1, 7.2, and 7.3 of this European Standard;