



# SLOVENSKI STANDARD

## SIST EN 14227-2:2013

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### Hidravlično vezane zmesi - Specifikacije - 2. del: Vezane zmesi z žlindro

Hydraulically bound mixtures - Specifications - Part 2: Slag bound mixtures

Hydraulisch gebundene Gemische - Anforderungen - Teil 2: Schlackengebundene Gemische

Mélanges traités aux liants hydrauliques - Specifications - Partie 2: Mélanges granulaires traités au laitier

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**Hydraulically bound mixtures - Specifications - Part 2: Slag  
bound granular mixtures**

Mélanges traités aux liants hydrauliques - Spécifications -  
Partie 2: Mélanges granulaires traités au laitier

Hydraulisch gebundene Gemische - Anforderungen - Teil 2:  
Schlackengebundene Gemische

This European Standard was approved by CEN on 1 March 2013.

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## EN 14227-2:2013 (E)

## Foreword

This document (EN 14227-2:2013) has been prepared by Technical Committee CEN/TC 227 "Road materials", 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of an identical text or by endorsement, at the latest by November 2013, and conflicting national standards shall be withdrawn at the latest by November 2013.

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 supersedes EN 14227-2:2004.

Compared with EN 14227-2:2004, the following changes have been made:

- Changing of the title;
- Revision of Clause 3 "Terms and definitions";
- Revision of Clause 4 "Symbols and abbreviated terms";
- Revision of Clause 5 "Constituents".

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This standard is one of a series of parts for EN 14227, *Hydraulically bound mixtures* — *Specifications*:

- *Part 1: Cement bound granular mixtures*
- *Part 2: Slag bound granular mixtures*
- *Part 3: Fly ash bound granular mixtures*
- *Part 4: Fly ash for hydraulically bound mixtures*
- *Part 5: Hydraulic road binder bound granular mixtures*
- *Part 10: Soil treated by cement*
- *Part 11: Soil treated by lime*
- *Part 12: Soil treated by slag*
- *Part 13: Soil treated by hydraulic road binder*
- *Part 14: Soil treated by fly ash*

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

## 1 Scope

This European Standard specifies slag bound granular mixtures for, roads, airfields, and other trafficked areas, and specifies the requirements for their constituents, composition and laboratory performance classification. In this European Standard slag refers to slag from the iron and steel industry.

## 2 Normative references

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

EN 459-1, *Building lime — Part 1: Definitions, specifications and conformity criteria*

EN 933-1, *Tests for geometrical properties of aggregates — Part 1: Determination of particle size distribution — Sieving method*

EN 1097-6:2000, *Tests for mechanical and physical properties of aggregates — Part 6: Determination of particle density and water absorption*

EN 1097-7, *Tests for mechanical and physical properties of aggregates — Part 7: Determination of the particle density of filler — Pyknometer method*

EN 13242, *Aggregates for unbound and hydraulically bound materials for use in civil engineering work and road construction*

EN 13286-1, *Unbound and hydraulically bound mixtures — Part 1: Test methods for laboratory reference density and water content — Introduction, general requirements and sampling*

EN 13286-2, *Unbound and hydraulically bound mixtures — Part 2: Test methods for laboratory reference density and water content — Proctor compaction*

EN 13286-3, *Unbound and hydraulically bound mixtures — Part 3: Test methods for laboratory reference density and water content — Vibrocompression with controlled parameters*

EN 13286-4, *Unbound and hydraulically bound mixtures — Part 4: Test methods for laboratory reference density and water content — Vibrating hammer*

EN 13286-5, *Unbound and hydraulically bound mixtures — Part 5: Test methods for laboratory reference density and water content — Vibrating table*

EN 13286-40, *Unbound and hydraulically bound mixtures — Part 40: Test method for the determination of the direct tensile strength of hydraulically bound mixtures*

EN 13286-41, *Unbound and hydraulically bound mixtures — Part 41: Test method for the determination of the compressive strength of hydraulically bound mixtures*

EN 13286-42, *Unbound and hydraulically bound mixtures — Part 42: Test method for the determination of the indirect tensile strength of hydraulically bound mixtures*

EN 13286-43, *Unbound and hydraulically bound mixtures — Part 43: Test method for the determination of the modulus of elasticity of hydraulically bound mixtures*

EN 13286-44, *Unbound and hydraulically bound mixtures — Part 44: Test method for the determination of the alpha coefficient of vitrified blast furnace slag*

EN 13286-45, *Unbound and hydraulically bound mixtures — Part 45: Test method for the determination of the workability period of hydraulically bound mixtures*

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EN 13286-47, *Unbound and hydraulically bound mixtures — Part 47: Test method for the determination of California bearing ratio, immediate bearing index and linear swelling*

EN 13286-50, *Unbound and hydraulically bound mixtures — Part 50: Method for the manufacture of test specimens of hydraulically bound mixtures using Proctor equipment or vibrating table compaction*

EN 13286-51, *Unbound and hydraulically bound mixtures — Part 51: Method for the manufacture of test specimens of hydraulically bound mixtures using vibrating hammer compaction*

EN 13286-52, *Unbound and hydraulically bound mixtures — Part 52: Method for the manufacture of test specimens of hydraulically bound mixtures using vibrocompression*

EN 13286-53, *Unbound and hydraulically bound mixtures — Part 53: Methods for the manufacture of test specimens of hydraulically bound mixtures using axial compression*

EN 15167-1, *Ground granulated blast furnace slag for use in concrete, mortar and grout — Part 1: Definitions, specifications and conformity criteria*

### 3 Terms and definitions

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

#### 3.1

##### **hydraulically bound mixture**

mixture which sets and hardens by hydraulic reaction

#### 3.2

##### **slag bound granular mixture**

hydraulically bound granular mixture whose performance relies on blast-furnace and or steel slag

Note 1 to entry:

The mixture may include an activator.

#### 3.3

##### **air-cooled blast furnace slag**

aggregate made mainly of crystalline silicates and aluminosilicates of calcium and magnesium, obtained by slow air cooling of molten blast furnace slag

Note 1 to entry: The cooling process may be assisted by the controlled application of water. Air-cooled blast furnace slag hardens by hydraulic reaction and carbonation.

#### 3.4

##### **air-cooled steel slag**

aggregate made mainly of crystalline calcium silicates and calcium ferrites comprising CaO, SiO<sub>2</sub>, MgO and iron oxides, obtained by slow air cooling of molten steel slag

Note 1 to entry: The cooling process may be assisted by the controlled application of water. Air-cooled steel slag hardens mainly by carbonatic reactions.

#### 3.5

##### **granulated blast furnace slag**

vitrified sandy material made up mainly of CaO, SiO<sub>2</sub>, Al<sub>2</sub>O<sub>3</sub> and MgO, produced generally by rapid water quenching of molten blast furnace slag

Note 1 to entry: Granulated blast furnace slag hardens by hydraulic reaction.

Note 2 to entry: Pelletised and dry granulated blast-furnace slag may have similar hydraulic properties.



**3.6****partially ground granulated blast furnace slag**

granulated blast furnace slag partially ground in order to increase the proportion of material finer than 0,063 mm

**3.7****ground granulated blast furnace slag**

granulated blast furnace slag more fully ground in order to further increase the proportion of material finer than 0,063 mm

**3.8****slenderness ratio**

height to diameter ratio of the specimen

**3.9****compactness**

ratio of the absolute volume of the solid to the apparent volume of the mixture (see Annex C)

**3.10****alpha ( $\alpha$ ) coefficient**

product of the specific surface of the natural elements of the slag smaller than 0,080 mm and the friability where the friability is the percentage of elements smaller than 0,080 mm obtained after grinding according to this European Standard

Note 1 to entry: The  $\alpha$  coefficient characterises the reactivity of a fresh vitrified blast furnace slag used for road construction (see EN 13286-44).

**4 Symbols and abbreviated terms**

For the purpose of this document, the following symbols and abbreviated terms apply.

CBR	is the California bearing ratio, expressed in percent (%)
$R_c$	is the compressive strength, expressed in megapascals (MPa)
$R_i$	is the compressive strength after immersion, expressed in megapascals (MPa)
$R_t$	is the direct tensile strength, expressed in megapascals (MPa)
$R_{it}$	is the indirect tensile strength, expressed in megapascals (MPa)
$E$	is the modulus of elasticity, expressed in megapascals (MPa)
$E_C$	is the $E$ determined by compressive strength, expressed in megapascals (MPa)
$E_t$	is the $E$ determined in direct tension, expressed in megapascals (MPa)
$E_{it}$	is the $E$ determined in indirect tension, expressed in megapascals (MPa)

**5 Constituents****5.1 Aggregates**

Aggregates shall comply with EN 13242.

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The properties and the appropriate categories of the aggregates shall be specified in accordance with regulations in the place of use.

Aggregates shall be volumetrically stable. When this is not the case, the use of the mixture shall be permitted provided there is a satisfactory performance record or a thorough laboratory evaluation of the mixture has been carried out in accordance with provisions valid in the place of use.

**5.2 Granulated blast furnace slag**

When required, the content of  $\text{SiO}_2$ ,  $\text{Al}_2\text{O}_3$ ,  $\text{CaO}$ ,  $\text{MgO}$  and the C.A category in accordance with Annex A (normative) shall be declared.

When required, the alpha coefficient category shall be declared in accordance with Annex A.

**5.3 Partially ground granulated blast furnace slag**

When required, the content of  $\text{SiO}_2$ ,  $\text{Al}_2\text{O}_3$ ,  $\text{CaO}$ ,  $\text{MgO}$  and the C.A category in accordance with Annex A shall be declared.

When required, the fines content category shall be declared in accordance with Annex A.

When required, the alpha coefficient category (measured before grinding) shall be declared in accordance with Annex A.

**5.4 Ground granulated blast furnace slag**

Ground granulated blast furnace slag shall conform to EN 15167-1.

**5.5 Water**

Water shall not contain components that adversely affect the hardening and performance of the slag bound mixture.

**5.6 Activators**

Activators include quick lime, hydrated lime, gypsum, air-cooled steel slag or other similar products containing lime and/or sulfate.

Quick lime ( $\text{CaO}$ ) or hydrated lime [ $\text{Ca}(\text{OH})_2$ ] shall be type CL90 or CL80 in conformity with EN 459-1.

Quick lime shall comply with reactivity R4 or R5 and particle size distribution P1, P2, P3 or P4.

**6 Slag bound granular mixtures****6.1 Types**

Using the constituents specified in Clause 5, slag bound granular mixture shall be selected from the types and sub-types described in 6.2 to 6.7 and shall conform to the specified requirements for the selected mixture.

**6.2 Slag bound granular mixture 1**

Granular mixture that contains granulated (or ground or partially ground granulated) blast furnace slag.

The grading of the mixture, determined in accordance with EN 933-1, shall comply with Table 1.

Table 1 — Grading of slag bound granular mixture 1

Column	1	3
Line	Slag bound granular mixture	Grading envelopes
1	1 – 0/31,5 G1 or G2	Figure 1
2	1 – 0/16	Figure 2
3	1 – 0/8	Figure 3

### 6.3 Slag bound granular mixture 2

Granular mixture with compacity requirement that contains granulated (or ground or partially ground granulated) blast furnace slag.

The grading of the selected sub-type, determined in accordance with EN 933-1, shall comply with Table 2.

Either category G1 or category G2 of the grading envelopes in Figures 4 to 6 shall be specified.

Compacity shall comply with 6.10.1.

Mixture 2 - 0/10 shall satisfy the immediate bearing index requirement stated in 6.10.2.

Table 2 — Grading of slag bound granular mixture 2

Column	1	2	3
Line	Slag bound granular mixture	Grading category	Grading envelopes
1	2 – 0/20	G1 or G2	Figure 4
2	2 – 0/14	G1 or G2	Figure 5
3	2 – 0/10	G1 or G2	Figure 6

### 6.4 Slag bound granular mixture 3

Granular mixture that contains granulated (or ground or partially ground granulated) blast furnace slag with a maximum nominal size of  $D$  equal or less than 6,3 mm and with an immediate bearing index requirement.

Slag bound granular mixture 3 shall be a mixture with a maximum nominal size of  $D$  equal or less than 6,3 mm with an immediate bearing index requirement.

The grading of the mixture, determined in accordance with EN 933-1, shall comply with Table 3.

The immediate bearing index category shall be selected from 6.10.2.

Table 3 — Grading of slag bound granular mixture 3

Column	1	2	3	4
Line	Sieve mm	$2D$	$D$	0,063
1	Percentage of mixture passing by mass	100	$\geq 85$	$\leq 35$

**EN 14227-2:2013 (E)****6.5 Slag bound granular mixture 4**

Granular mixture with manufacturer declared value for the grading including declared upper and lower limits and, when required, an immediate bearing index category selected from Table 5.

The grading of the mixture shall be determined in accordance with EN 933-1.

**6.6 Slag bound granular mixture 5**

Granular mixture that contains granulated (or ground or partially ground granulated) blast furnace slag.

The grading of the mixture when tested in accordance with EN 933-1 shall comply with Table 4.

When required, the immediate bearing index category shall be selected from Table 5.

**Table 4 — Grading of slag bound granular mixture 5**

Sieve mm	Percentage of mixture passing by mass	
	Minimum	Maximum
45	100	100
31,5	75	100
16	50	100
8	35	100
4	25	100
2	15	100
0,5	5	75
0,25	3	60
0,063	0	25

**6.7 Examples of slag bound granular mixture**

Examples of slag bound granular mixtures are given in Annex B.

NOTE The examples are not exhaustive, nor the proportions intended to be restrictive, but they illustrate the current use in Europe.

**6.8 Water content of mixtures**

The water content shall be selected to permit compaction on site by rolling and to optimise the mechanical performance of the mixture. The water content shall be determined by the Proctor test or other method in accordance with EN 13286-1, EN 13286-2, EN 13286-3, EN 13286-4 and EN 13286-5, and limits set to give a workable range of water content on site compatible with the compaction and the desired mechanical performance of the mixture.

**6.9 Proportioning of the constituents, grading and dry density for mixtures**

The proportioning of the constituents, expressed as a percentage by dry mass of the total dry mass of the mixture, the target grading, including lower and upper limits, if required, and the dry density of the mixture, shall be declared. The declared proportions shall be based on the laboratory mixture design and/or practical experiences with mixtures produced with the same constituents and under the same conditions in a way that the mixture complies with the requirements of this European Standard.