BRITISH STANDARD

BS EN
13286-3:2003

Unbound and hydraulically bound mixtures —

Part 3: Test methods for laboratory reference density and water content — Vibrocompression with controlled parameters

The European Standard EN 13286-3:2003 has the status of a British Standard

ICS 93.080.20

National foreword

This British Standard is the official English language version of EN 13286-3:2003.

The UK participation in its preparation was entrusted by Technical Committee B/510, Road materials, to Subcommittee B/510/4, Cementitious bound materials, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

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Ungebundene und hydraulisch gebundene Gemische - Teil 3: Laborprüfverfahren für die Trockendichte und den Wassergehalt - Vibrationsverdichtung mit vertikalem Druck

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Contents

Foreword

This document (EN 13286-3:2003) 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of an identical text or by endorsement, at the latest by September 2003, and conflicting national standards shall be withdrawn at the latest by December 2003.

This European Standard is one of a series of standards as follows:

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

prEN 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.*

prEN 13286-7, *Unbound and hydraulically bound mixtures — Part 7: Cyclic load triaxial test for unbound mixtures.*

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 methods for the determination of the compressive of 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.*

prEN 13286-44, *Unbound and hydraulically bound mixtures — Part 44: Test method for the determination of the alpha coefficient of vitrified blastfurnace slag.*

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

EN 13286-46, *Unbound and hydraulically bound mixtures — Part 46: Test method for the determination of the moisture condition value.*

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

prEN 13286-48, *Unbound and hydraulically bound mixtures — Part 48: Test method for the determination of the degree of pulverisation.*

prEN 13286-49, *Unbound and hydraulically bound mixtures — Part 49: Test method for the determination of the accelerated swelling of soil treated by lime and/or hydraulic binder.*

prEN 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.*

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

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

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

Annex A is informative.

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, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovak Republic, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This European Standard specifies a method for the determination of the laboratory dry density, the water content and the difficulty of compaction of a hydraulically bound or unbound mixture using vibrocompression with controlled parameters.

This European Standard applies to unbound mixtures as well as to mixtures bound with hydraulically binders before setting.

This method is applicable to mixture with a maximum size aggregate D equal to 31,5 mm.

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 13286-1:2003, *Unbound and hydraulically bound mixtures – Part 1: Test methods for laboratory reference density and water content – Introduction, general requirements and sampling.*

3 Terms and definitions

For the purposes of this European Standard, the terms and definitions given in EN 13286-1:2003 and the following apply.

3.1
difficulty of compaction DC(w)
difficulty of the mixture to be compacted

4 Principle

The material is compacted into a mould by means of circular horizontal vibration and an increasing vertical axial pressure P(t). The dry density at frequencies of 50 Hz and 100 Hz are measured and the laboratory dry density $_{dR}$, and the difficulty of compaction DC(w), of the mixture are calculated.

5 Apparatus

5.1 Cylindrical steel mould, see Figure 1, with the following dimensions:

¾ a wall of minimum thickness 10 mm;

¾ an internal diameter of (152,0 0,2) mm;

¾ of sufficient height so that the mould can contain enough mixture which after compaction at 100 Hz has a height in the mould of (152 5) mm;

¾ a removable base plate fitted with a watertight seal.

5.2 Vibrators, which apply to the mould a horizontal circular vibration of amplitude (0,80 0,08) mm at frequencies of (50 3) Hz and (100 3) Hz;

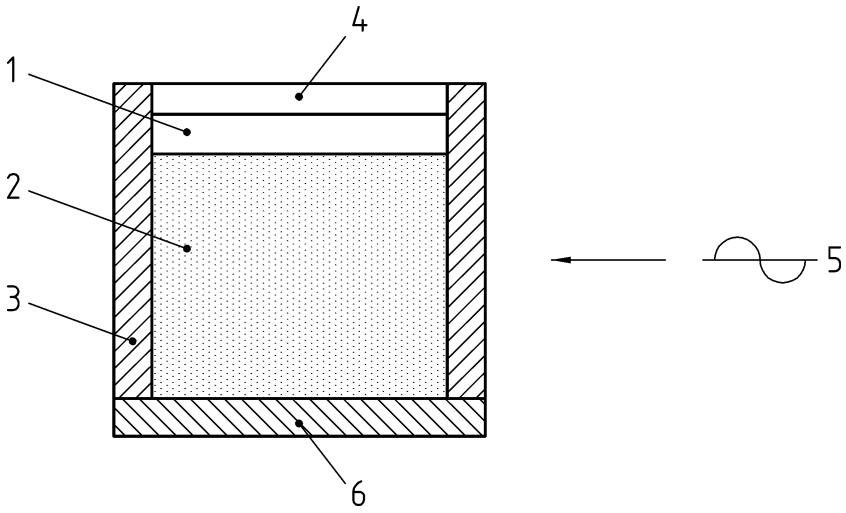
5.3 **Piston**, of diameter (151,0 0,2) mm allowing a variable pressure, P(t) (10 %), to be applied to the mixture during compaction (see Figure 2) according to the following formula:

$$P(t) = 0{,}441 \quad t/(22{,}5 \quad 6{,}5 \quad t) \tag{1}$$

where

P(t) is the axial pressure applied to the material in the mould after a compaction time of t, in megapascals (MPa);

t is the compaction time, in minutes (min).



Key

1	Piston	4	Vibration
2	Mixture	5	Axial pressure
3	Mould	6	Removable base plate

Figure 1 — Diagram of the machine

5.4 **Facility to measure the height of the mixture in the mould**, within 0,5 %, at the end of the test.

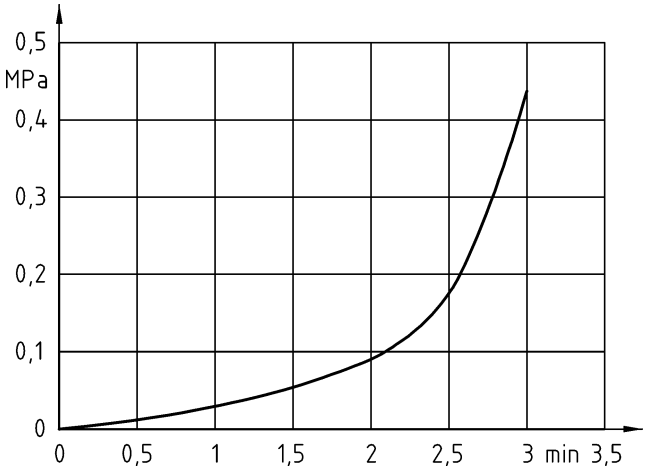


Figure 2 — Variation of the axial pressure, P(t), on the mixture in the mould after the compaction time t, in megapascal

6 Preparation of the mixture

6.1 Mass of the mixture

The dry mass m of the mixture to be introduced into the mould shall be in the range 6,0 kg to 6,5 kg.

Determine the test portion's mass m_0 by introducing a test portion m with a water content w approximately equal to the work site water content. Compact it during 3 min at 100 Hz with a pressure P(t). Measure the height h of the specimen after compaction and then determine m_0 from m to get a height after compaction equal (152 5) mm by the formula:

$$m_0 = 152 \quad m/h \tag{2}$$

where

m_0 is the mass of the test portion to be introduced into the mould, in grams (g) (1 %);

m is the mass of the test portion with the water content w; in grams (g);

h is the height of the test portion after compaction, in millimetres (mm).

6.2 Water content

Choose at least three different water contents over a range close to that expected on site, the difference between two successive water contents shall be less than 1,5 %. Prepare four test portions at each chosen water content: two for testing at 100 Hz and two for testing at 50 Hz.

7 Procedure

Determine the dry density $_{dR}$ of a test portion using the following procedure.

Introduce the test portion mass m_0 with a water content w into the mould.

Compact it during 3 min with a vibration at 50 Hz or 100 Hz and an axial pressure P(t).

Measure the height h of the specimen after compaction.

Calculate the dry density of the specimen using the formula:

$$_{d}(w) = 5{,}51 \quad m_0/(100 + w) \quad h \qquad (3)$$

where

$_{d}(w)$ is the laboratory dry density of the test portion, in megagrams per cubic metre (Mg/m^3);

m_0 is the mass of the test portion to be introduced into the mould, in grams (g) (1 %);

w is the water content of the test portion, in percentage of the mass of water to the mass of the dry mixture (%);

h is the height of the specimen after compaction, in millimetres (mm).

Obtain the value of $_{d}(w)$ by the average of the result of at least two repetitions in accordance with 6.2.

The results shall be:

¾ with tests conducted at 100 Hz, the values: $_{d100}(w_1)$ $_{d100}(w_2)$ $_{d100}(w_3)$

¾ with tests conducted at 50 Hz, the values: $_{d50}(w_1)$ $_{d50}(w_2)$ $_{d50}(w_3)$.

8 Calculation of $_{R}$ and the difficulty of compaction $DC(w)$

Plot the curve $_{d100}(w)$, $_{dR}$ is equal to the highest value of $_{d100}(w)$.

Calculate $DC(w)$ for each water content according to the following formula:

$$DC(w) = 100 \quad (\ _{dR} \quad _{d50}(w))/\ _{dR} \qquad (4)$$

where

$DC(w)$ is the difficulty of compaction of the test portion at the water content w;

$_{dR}$ is the laboratory dry density of the test portion, in megagrams per cubic metre (Mg/m^3);

$_{d50}(w)$ is the dry density of the test portion after 3 min compaction at 50 Hz, in megagrams per cubic metre (Mg/m^3).

Plot the curve $DC(w)$.

9 Test report

The test report shall include at least the following information.

a) reference to this European Standard;

b) identification of the sample;

c) identification of the laboratory;

d) date of test;

e) results of the test:

- reference dry density, $_{dR}$;
- curve of difficulty of compaction, DC(w);

f) details not foreseen in this European Standard, and any incident which could have affected the results.

If required, the test report shall also include the following optional information:

g) name and description of the sample source;

h) description of the material.

10 Precision

To be added later.

Annex A
(informative)

Assessment of the difficulty compaction class

The difficulty of compaction DC(w) by roller compactors is assessed as follows in relation to the water content:

¾ if DC(w) < 5,5 % the material is easy to compact and classified DC_1;

¾ if 5,5 % DC(w) 11 % the material is fairly difficult to compact and classified DC_2;

¾ if DC(w) > 11 % the material is difficult to compact and classified DC_3.

w %	$_{d100}$(w) Mg/m^3	$_{d50}$(w) Mg/m^3	DC(w) %
4	2,14	2,00	13,4
5,1	2,31	2,12	8,2
5,6	2,30	2,17	6,1
6,2	2,29		

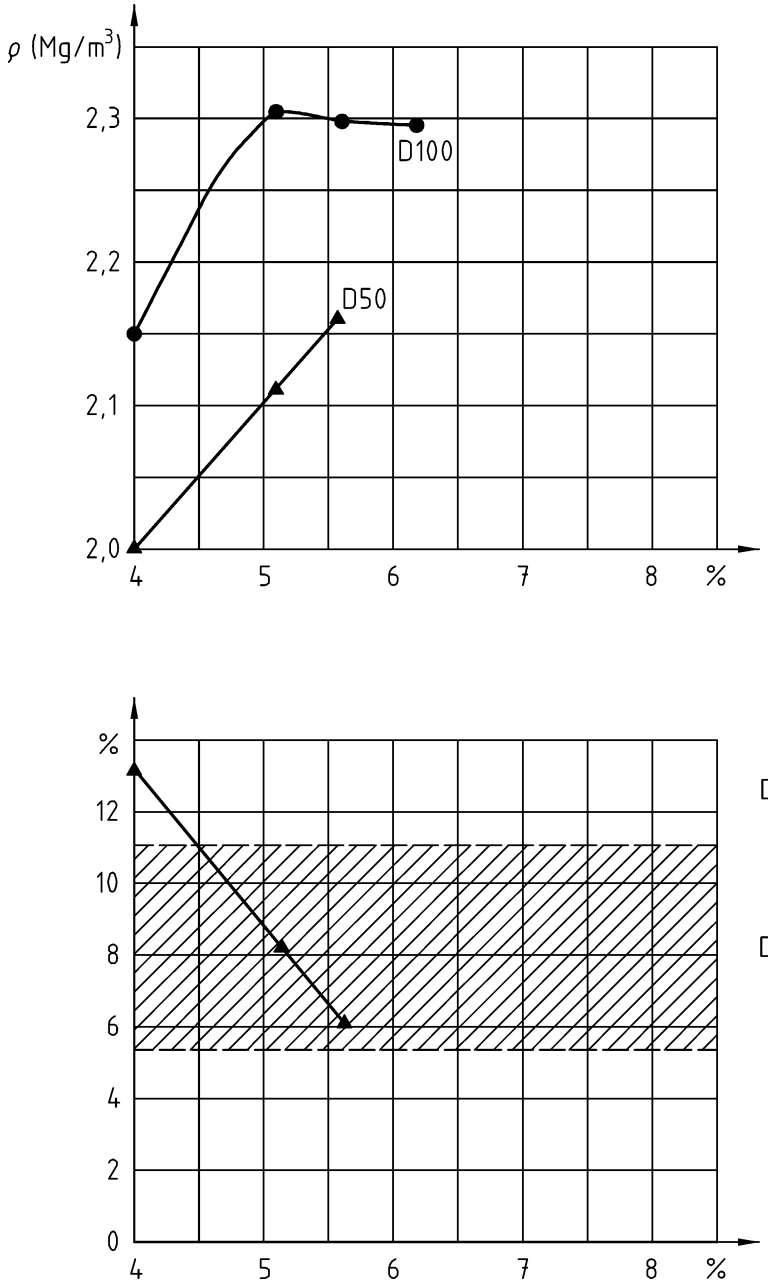


Figure A.1 — EXAMPLE $DC(w) = 100 \quad (\ _{R} \quad _{d50}(w))/\ _{dR}$

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