BRITISH STANDARD

BS 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

The European Standard EN 13286-1:2003 has the status of a British Standard

ICS 93.080.20

BSI
British Standards

National foreword

This British Standard is the official English language version of EN 13286-1:2003.

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.

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the *BSI Catalogue* under the section entitled "International Standards Correspondence Index", or by using the "Search" facility of the *BSI Electronic Catalogue* or of British Standards Online.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 14 March 2003

Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 12, an inside back cover and a back cover.

The BSI copyright date displayed in this document indicates when the document was last issued.

Amendments issued since publication

Amd. No.	Date	Comments

ISBN 0 580 41417 5

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 13286-1

March 2003

ICS 93.080.20

English version

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

Mélanges traités et mélanges non traités aux liants hydrauliques - Partie 1: Méthodes d'essai pour la masse volumique de référence et la teneur en eau en laboratoire - Introduction, exigences générales et échantillonnage

Ungebundene und hydraulisch gebundene Gemische - Teil 1: Laborprüfverfahren für die Trockendichte und den Wassergehalt - Einführung, allgemeine Anforderungen und Probenahme

This European Standard was approved by CEN on 12 December 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, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovak Republic, 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 13286-1:2003 E

Contents

Foreword

This document (EN 13286-1:2003) 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 normative.

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 number of test methods for the determination of the relationship between the water content and the density of unbound and hydraulically bound mixtures under specified test conditions. The test results provide an estimate of the mixture density that can be achieved on construction sites and provides a reference parameter for assessing the density of the compacted layer of the mixture.

The test results are used as a basis for specifying requirements for hydraulically bound and unbound mixtures before use in road construction. The test result also allows a conclusion to be drawn as to the water content at which a mixture can be satisfactorily compacted in order to achieve a given density.

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 932-1:1996, *Tests for general properties of aggregates – Part 1: Methods for sampling.*

EN 932-2:1999, *Tests for general properties of aggregates – Part 2: Methods for reducing laboratory samples.*

EN 932-5, *Tests for general properties of aggregates – Part 5: Common equipment and calibration.*

EN 1097-5, *Tests for mechanical and physical properties of aggregates – Part 5: Determination of the water content by drying in a ventilated oven.*

3 Terms and definitions

For the purposes of this European Standard, the terms and definitions given in EN 932-1:1996, EN 932-2:1999 and the following apply.

3.1
laboratory dry density
maximum dry density that can be determined from the dry density/water content relationship derived using a specified test method

3.2
optimum water content
water content associated with the maximum value of laboratory dry density

3.3
aggregate size
designation of aggregate in terms of lower (d) and upper (D) sieve sizes expressed as d/D

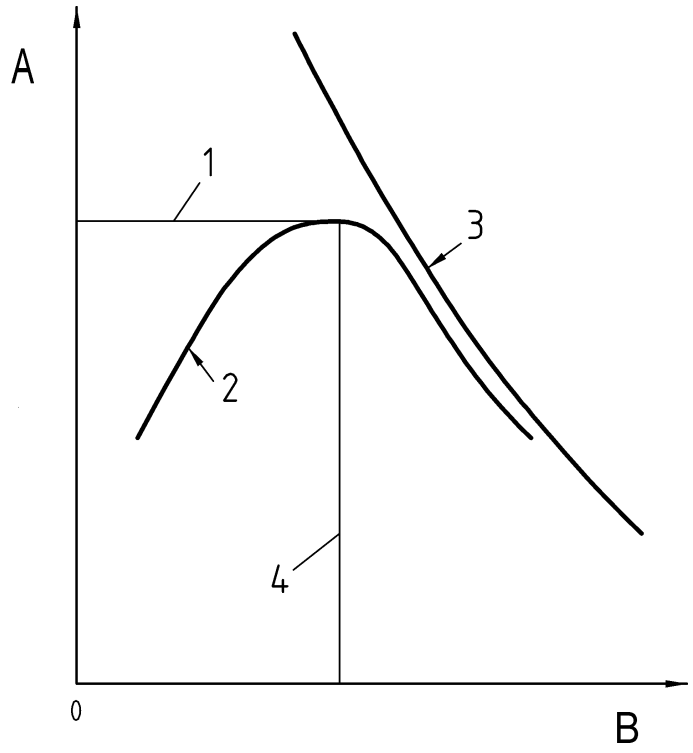
NOTE This designation accepts the presence of some particles which will be retained on the upper sieve (oversize) and some which will pass the lower sieve (undersize). The lower sieve size (d) may be zero.

4 Principle

4.1 Relationship between dry density and water content

The solid particles of unbound and hydraulically bound mixtures are compacted, i.e. packed more closely together, thereby increasing the dry density of the mixture. The dry density which can be achieved depends on the effective compaction work applied and on the amount of water present in the mixture.

For a given degree of compaction work applied to a particular mixture an optimum water content exists at which the dry density obtained reaches a maximum value. These principles are illustrated in Figure 1.



Key

1	Maximum value of laboratory dry density	3	0 % air void line for a given particle density, saturation line
2	Compaction curve	4	Optimum water content
A	Dry density, megagrams per cubic metre	B	Water content, per cent

Figure 1 — Dry density/water content relationship curve

NOTE 1 The mixtures which are not free-draining will, in most cases, establish a well defined optimum water content and maximum density. However, for free-draining mixtures, the laboratory tests will not, in many cases, produce a well defined water density relationship. The maximum density obtained will generally be less than that obtained in the finished pavement layer.

NOTE 2 For free-draining mixtures it is possible to draw two curves: one for the relationship between the dry density and the initial water content (before compaction) and another for the relationship between the dry density and the final water content (after compaction). The possible difference between these curves shows the draining capacity of the mixture.

4.2 Choice of test method

The following four test methods are used for compaction:

¾ prEN 13286-2: Proctor compaction;

¾ EN 13286-3: Vibrocompression with controlled parameters;

¾ EN 13286-4: Vibrating hammer;

¾ EN 13286-5: Vibrating table.

Each method applies different levels of compactive effort, and is suitable for different aggregate sizes.

In the Proctor compaction, vibrocompression and vibrating hammer methods the relationship between the dry density and water content of a mixture is determined.

NOTE 1 The Proctor compaction method allows a choice between three mould sizes depending upon aggregate size. Three different hammer masses may be used.

In the vibrating table method the water content of the mixture at this maximum dry density is determined,

NOTE 2 The vibrating table method is suitable for mixtures which drain easily.

The range of applicability of each method is given in Table 1.

Table 1 — Choice of test method

Test method			Particle size range	
Proctor compaction	2,5 kg hammer	100 mm mould	maximum size	16 mm
		150 mm mould	75 to 100 percentage passing	31,5 mm
	4,5 kg hammer	100 mm mould	maximum size	16 mm
		150 mm mould	75 to 100 percentage passing	31,5 mm
	15 kg hammer	250 mm mould	75 to 100 percentage passing	63 mm
Vibrocompression with controlled parameters			maximum size	31,5 mm
Vibrating hammer			90 to 100 percentage passing 70 to 100 percentage passing	20 mm 40 mm
Vibrating table			maximum size less than 12 percentage passing	80 mm 0,063 mm

4.3 Determination of water content

Where required the water content is determined by oven drying to constant mass using the procedures set out in EN 1097-5.

The minimum size of the test portion used to determine water content is 0,2 D kg, where D is the aggregate size of the mixture.

If all of a mixture passes the 1 mm sieve, at least 0,2 kg is used.

NOTE It may be convenient to use all the contents of a mould.

The water content of a compacted specimen is determined as soon as possible after completion of compaction.

4.4 Sampling and sample reduction

Sampling and sample reduction are given in EN 932-1 and EN 932-2 with additional requirements given in annex A.

5 Apparatus

All apparatus shall conform to the general requirements of EN 932-5. Where required, specific requirements for the calibration of particular items of apparatus shall be given in an annex to the relevant part of the series of EN 13286.

6 Test specimen preparation for other test methods

The methods described in prEN 13286-2 to EN 13286-5 may be used to prepare compacted test specimens for use with other test methods.

NOTE This procedure will usually involve mixtures with hydraulic binders.

Annex A
(normative)

Sampling and sample reduction

A.1 General

This annex describes methods for:

¾ obtaining samples of unbound and hydraulically bound mixtures after manufacture or at the point of delivery;

¾ reducing the size of the sample prior to submission to a laboratory;

¾ reducing the sample submitted to the laboratory to test portion size.

NOTE 1 The methods described are based on manual procedures. Mechanical devices can be used, subject to the criteria for mechanical sampling apparatus set out in EN 932-1.

NOTE 2 Where necessary, the method of dividing the test portion into a number of test specimens is given in the relevant test method.

A.2 Principle

A bulk sample is obtained that is representative of the average properties of the batch.

NOTE Principles of sampling and sample reduction are given in EN 932-1.

A.3 Bulk sample size and number of increments

The total size of the bulk sample shall be at least twice the quantity estimated as being required for the tests to be carried out, with a minimum mass of 10 kg. The bulk sample shall consist of at least five increments.

NOTE 1 The use of twice the required quantity allows for repeated tests to resolve anomalous or disputed test results.

NOTE 2 Guidance on the amount of mixture required for each test is given in Table A.1. The values given are based on a loose bulk density of 2,0 Mg/m^3.

Table A.1 — Guidance on the mass of mixture required for laboratory dry density and water content tests

Test method		Minimum mass kg
Part 2: Proctor compaction	100 mm mould or 150 mm mould	15
	150 mm mould	40
	250 mm mould	200
Part 3: Vibrocompression with controlled parameters		10
Part 4: Vibrating hammer		40
Part 5: Vibrating table		45
NOTE For other test methods guidance on the size of the bulk sample is given in EN 932-1.		

A.4 Sampling plan

The sampling plan shall conform to the requirements in EN 932-1.

NOTE 1 The sampler should be aware that all mixtures are prone to segregation. Mixtures with a value of upper, D, sieve size greater than 20 mm or which contain aggregates of differing particle densities are particularly liable to segregation.

NOTE 2 The sampling plan can include details of the number of samples to be taken and/or the frequency of sampling. This information can be defined in a system of factory production control.

A.5 Apparatus

All apparatus shall conform to the requirements in EN 932-1.

NOTE The following items are used: Scoop, shovel, sampling tray, riffle box and containers (for transport).

A.6 Sampling procedures

The sampling procedure chosen shall conform to the requirements in EN 932-1.

NOTE 1 The following methods are used:
– sampling from stationary conveyor belts;
– sampling at belt and chute discharge points;
– sampling from stockpiles.

NOTE 2 The outside of a stockpile of a mixture may not be representative of the average properties. It can be appropriate to use a loading shovel to take a series of increments to form a secondary stockpile from which a representative sample can be taken.

NOTE 3 If a sample of an uncompacted mixture in a layer is required, the layer is considered as a flat stockpile. This method is appropriate for "mix in-place".

A.7 Sample reduction

If it is necessary to reduce the size of the bulk sample for submission to a laboratory, the methods in EN 932-1 shall be used.

A.8 Test portion preparation

If it is necessary to reduce the size of the laboratory sample to produce one or more test portions, the procedures described in EN 932-2 shall be used.

A.9 Marking, packaging and dispatch

Marking, packaging and dispatch of the samples shall conform to the requirements in EN 932-1.

A.10 Sampling report

The sampling report shall conform to the requirements in EN 932-1 but with the following additions.

The sampling report shall refer to this European Standard and shall also include:

a) ambient temperature and weather conditions;

b) temperature of the sample.

NOTE The information in a) and b) can also be appropriate for hydraulically bound mixtures.

Bibliography

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.*

blank

BSI — British Standards Institution

BSI is the independent national body responsible for preparing British Standards. It presents the UK view on standards in Europe and at the international level. It is incorporated by Royal Charter.

Revisions

British Standards are updated by amendment or revision. Users of British Standards should make sure that they possess the latest amendments or editions.

It is the constant aim of BSI to improve the quality of our products and services. We would be grateful if anyone finding an inaccuracy or ambiguity while using this British Standard would inform the Secretary of the technical committee responsible, the identity of which can be found on the inside front cover. Tel: +44 (0)20 8996 9000. Fax: +44 (0)20 8996 7400.

BSI offers members an individual updating service called PLUS which ensures that subscribers automatically receive the latest editions of standards.

Buying standards

Orders for all BSI, international and foreign standards publications should be addressed to Customer Services. Tel: +44 (0)20 8996 9001. Fax: +44 (0)20 8996 7001. Email: orders@bsi-global.com. Standards are also available from the BSI website at http://www.bsi-global.com.

In response to orders for international standards, it is BSI policy to supply the BSI implementation of those that have been published as British Standards, unless otherwise requested.

Information on standards

BSI provides a wide range of information on national, European and international standards through its Library and its Technical Help to Exporters Service. Various BSI electronic information services are also available which give details on all its products and services. Contact the Information Centre. Tel: +44 (0)20 8996 7111. Fax: +44 (0)20 8996 7048. Email: info@bsi-global.com.

Subscribing members of BSI are kept up to date with standards developments and receive substantial discounts on the purchase price of standards. For details of these and other benefits contact Membership Administration. Tel: +44 (0)20 8996 7002. Fax: +44 (0)20 8996 7001. Email: membership@bsi-global.com.

Information regarding online access to British Standards via British Standards Online can be found at http://www.bsi-global.com/bsonline.

Further information about BSI is available on the BSI website at http://www.bsi-global.com.

Copyright

BSI
389 Chiswick High Road
London
W4 4AL