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Nevezane in hidravlično vezane zmesi - 2. del: Preskusne metode za določanje laboratorijske referenčne gostote in deleža vlage - Preskus po Proctorju

Unbound and hydraulically bound mixtures - Part 2: Test methods for laboratory reference density and water content - Proctor compaction

Ungebundene und hydraulisch gebundene Gemische - Teil 2: Laborprüfverfahren zur Bestimmung der Dichte und des Wassergehaltes - Proctorversuch

Mélanges traités et mélanges non traités - Partie 2: Méthodes d'essai de détermination en laboratoire de la masse volumique de référence et de la teneur en eau - Compactage Proctor

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ICS:

93.080.20	Materiali za gradnjo cest	Road construction materials

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EUROPEAN STANDARD

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COMITÉ EUROPÉEN DE NORMALISATION
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Contents

Foreword

This document (EN 13286-2:2010) 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of an identical text or by endorsement, at the latest by March 2011, and conflicting national standards shall be withdrawn at the latest by March 2011.

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 13286-2:2004.

This document is one of a series of standards as listed below.

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 13286-7, *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 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*

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

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

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

EN 13286-49, *Unbound and hydraulically bound mixtures — Part 49: Accelerated swelling test for soil treated by lime and/or hydraulic binder*

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*

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

1 Scope

This European Standard specifies test methods for the determination of the relationship between the water content and the dry density of hydraulically bound or unbound mixtures after compaction under specified test conditions using Proctor compaction. It allows 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.

This European Standard applies only to unbound and hydraulically bound mixtures of aggregates used in road construction and civil engineering work. It is not applicable to soils for earthworks. The results of this test method can be used as a basis for comparing mixtures before use in road construction. The test results also allow a conclusion to be drawn as to the water content at which mixtures can be satisfactorily compacted in order to achieve a given dry density.

This test is suitable for mixtures with different values of upper sieve (*D*) size up to 63 mm and an oversize up to 25 % by mass.

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

EN 933-2, *Tests for geometrical properties of aggregates — Part 2: Determination of particle size distribution — Test sieves, nominal size of apertures*

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

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

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 document, the terms and definitions given in EN 13286-1:2003 and the following apply.

3.1
Proctor density
laboratory reference density determined from the dry density/water content relationship obtained by the Proctor test with a specific energy of approximately 0,6 MJ/m^3

3.2
modified Proctor density
laboratory reference density determined from the dry density/water content relationship obtained by the modified Proctor test with a specific energy of about 2,7 MJ/m^3

3.3
initial water content w_{0i}
water content of a given mixture sample *i* before compaction

3.4
final water content w_{Fi}
water content of a given mixture sample i after compaction

3.5
bleeding water content w_B
maximum value of the initial water content for which there is no loss of water during compaction

NOTE $w_0 - w_F \leq 0,3$ %

3.6
self-draining mixture
mixture for which a loss of water occurs during compaction preventing the definition of a maximum dry density on the Proctor curve

NOTE $w_0 - w_F > 0,3$ %

3.7
dry density at bleeding ρ_{dB}
laboratory reference dry density of the self-draining mixture

4 Principle

Six similar compaction tests are described, each with procedural variations related to the maximum particle size of the mixture to be investigated, the required quantity of sample and the size of the mould. In the Proctor test a 2,5 kg rammer is used. In the modified Proctor test a much greater degree of compaction is added by using different rammers (4,5 kg or 15 kg) and/or greater drops on thinner layer of material as in the Proctor test. The size of the compaction mould is chosen in relation to the value of D. If oversize particles are present equivalent tests are carried out in larger moulds. If more than 25 % of material is retained on a 63 mm test sieve, the test method is not suitable.

5 Apparatus

5.1 Cylindrical test moulds, fitted with a removable extension not less than 50 mm high and a detachable steel base plate as shown in Figure 1. The mould shall have a smooth finish on inside face. The dimensions of moulds (Proctor mould (A), large Proctor mould (B) and extra large Proctor mould (C)) shall be as given in Table 1. The diameter of the mould shall be at least four times of D of the mixture.

Table 1 — Dimensions of new cylindrical test moulds

Proctor mould	Diameter d_1 mm	Height h_1 mm	Thickness	
			Wall w mm	Base plate t mm
A	100,0 ± 1,0	120,0 ± 1,0	7,5 ± 0,5	11,0 ± 0,5
B	150,0 ± 1,0	120,0 ± 1,0	9,0 ± 0,5	14,0 ± 0,5
C	250,0 ± 1,0	200,0 ± 1,0	14,0 ± 0,5	20,0 ± 0,5
NOTE Annex A gives details of other cylindrical test moulds which may be in current use.				

Dimensions in millimetre

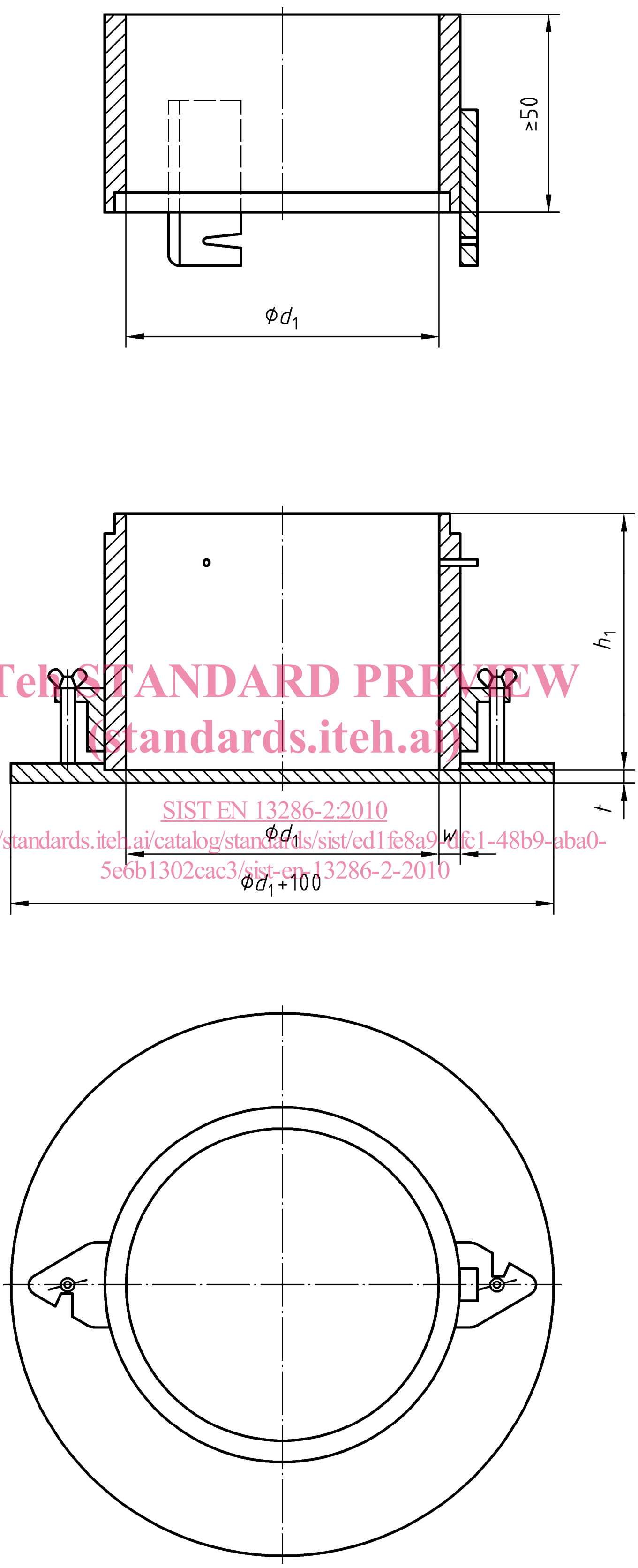


Figure 1 — Principle of Proctor mould

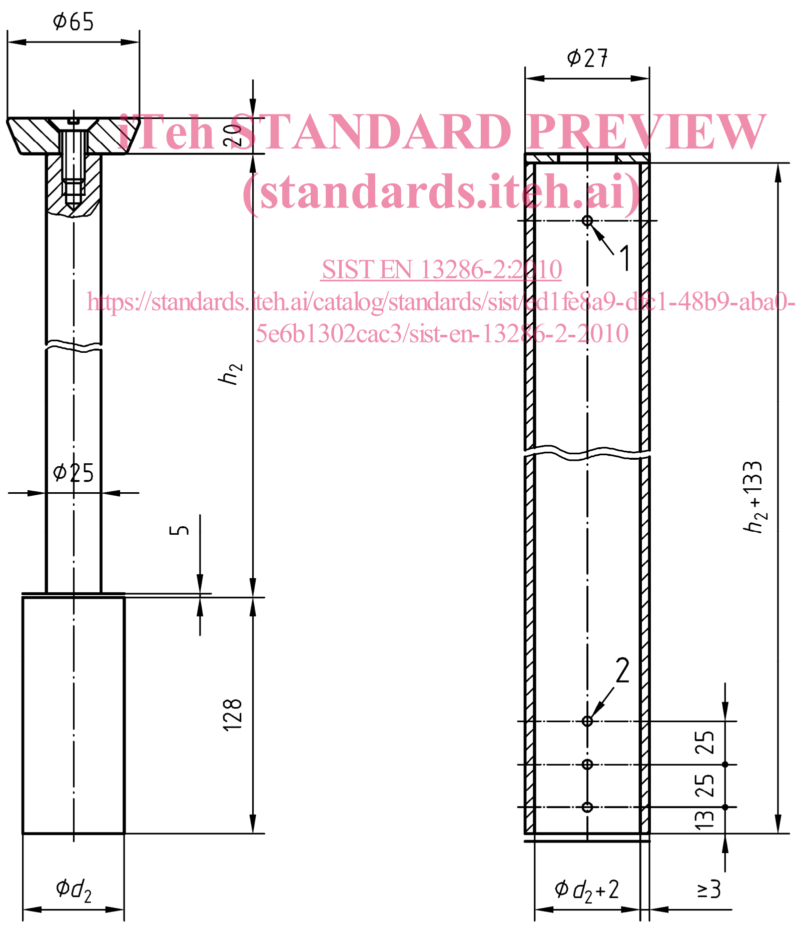
5.2 Compactor, consisting of a rammer which is allowed to fall freely onto a defined part of the upper surface of the mixture in the mould. The essential requirements of the rammers shall be as given in Table 2.

Table 2 — Essential requirements of new rammers

Rammer	Essential requirements		
	Mass of rammer m_R kg	**Diameter of base d_2** mm	**Height of fall h_2** mm
A	2,50 ± 0,02	50,0 ± 0,5	305 ± 3
B	4,50 ± 0,04	50,0 ± 0,5	457 ± 3
C	15,00 ± 0,04	125,0 ± 0,5	600 ± 3
NOTE Annex A gives details of other rammers which can be in current use.			

NOTE 1 Different types of rammer are used to apply different energy levels. An example of a rammer is given in Figure 2.

Dimensions in millimetres



Key

1 4 holes ∅6

2 12 holes ∅6

Figure 2 — Principle of rammer and guide

The rammer shall be equipped with a suitable arrangement for adjusting the height of drop to suit the level of the upper surface of the mixture in the mould.

NOTE 2 The design shown in Figure 2 has been found to be satisfactory, but alternative designs, including automatic compactors, may be used provided the essential requirements in Table 2 or Annex A are conformed to and the alternative design gives the same results.

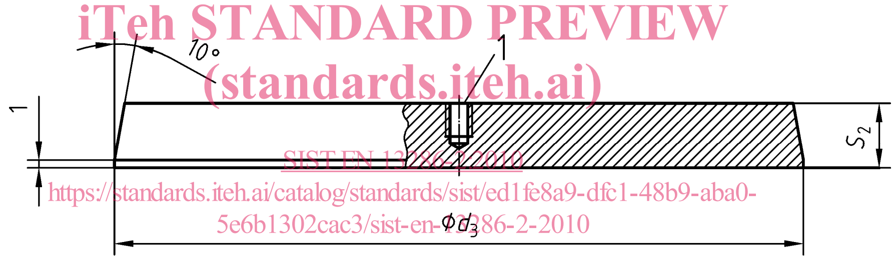
5.3 Steel plate, conforming to Table 3.

NOTE For the end of compaction on the last layer a steel plate (see Figure 3) may be used.

Table 3 — Dimensions of the steel plate

Proctor mould	Diameter d_3 mm	Thickness S_2 mm
A	$d_1 - 0{,}5$	10,0 ± 0,1
B		
C		20,0 ± 0,1
NOTE The design of the steel plate is shown in Figure 3.		

Dimensions in millimetres



Key

1 Thread for screwing in handle

Figure 3 — Principle of steel plate

5.4 Test sieves, conforming to EN 933-2.

5.5 Balances, readable to 0,1 % of the compacted sample mass.

5.6 Corrosion-resistant metal or plastics mixing tray, with sides about 80 mm deep, of a size suitable for the quantity of material to be used.

5.7 Spatula, trowel or similar tool.

5.8 Steel straightedge, of length 200 mm or more; one edge shall be bevelled if the rule is thicker than 3 mm, or palette knife with straight blade.

5.9 Apparatus for determination of water content, conforming to EN 1097-5.

5.10 Vernier depth gauge, readable to 0,02 mm.

5.11 Mixer, with a volume of at least 0,01 m^3.

5.12 Concrete block (min. 50 kg), as support for the compaction by means of manually operated rammer.

6 Preparation

6.1 General

Compaction of the mixture sample shall be carried out in a cylindrical test mould, the dimensions of which are a function of the particle size of the mixture sample.

The quantity of sample required and the size of the test mould shall be selected according to Table 4.

Table 4 — Summary of sample preparation methods

Percentage passing test sieves			Preparation, clause	Mass of sample kg	Proctor mould
16 mm	31,5 mm	63 mm			
100	–	–	6.4	15	A
				40	B
75 to 100	100	–	6.5.1	40	B
< 75	75 to 100	100	6.5.2	40	B
–	< 75	75 to 100	6.5.3	200	C

Table 5 summarizes the different types of tests by defining the permitted combinations of mould size and rammer mass.

NOTE The specifications for compaction in the larger moulds are based on the same compaction effort per unit of volume of the mixture as in the smaller mould. The variable effects of the sidewall friction can result in differences between the densities achieved in the two moulds. For a series of tests on a particular mixture, one size of mould should be used consistently.

Table 5 — Summary of Proctor test and modified Proctor test

Type of test	Characteristics of test	Symbol	Dimension	Proctor mould A	Proctor mould B	Proctor mould C
Proctor test	Mass of rammer	m_R	kg	2,5	2,5	15,0
	Diameter of rammer	d_2	mm	50	50	125,0
	Height of fall	h_2	mm	305	305	600
	Number of layers	–	–	3	3	3
	Number of blows per layer	–	–	25	56	22
Modified Proctor test	Mass of rammer	m_R	kg	4,5	4,5	15,0
	Diameter of rammer	d_2	mm	50	50	125,0
	Height of fall	h_2	mm	457	457	600
	Number of layers	–	–	5	5	3
	Number of blows per layer	–	–	25	56	98
For the routine control of pavement layers the one point Proctor test in Annex B may be used.						
NOTE In this table, the values for the dimensions are rounded. For the exact values see Table 2.						