BS EN 13285:2010

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Unbound mixtures — Specifications

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National foreword

This British Standard is the UK implementation of EN 13285:2010. It supersedes BS EN 13285:2003 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee B/510/4, Cementitious bound materials, unbound granular materials, waste materials and marginal materials.

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

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

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Graves non traitées - Spécifications

Ungebundene Gemische - Anforderungen

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Foreword

This document (EN 13285:2010) 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of an identical text or by endorsement, at the latest by March 2011, and conflicting national standards shall be withdrawn at the latest by March 2011.

This document supersedes EN 13285:2003.

The main change compared to the previous edition is that the former informative annex classifying mixtures containing recycled aggregates has been replaced by the general reference to EN 13242.

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1 Scope

This European Standard specifies requirements for unbound mixtures used for construction and maintenance of roads, airfields and other trafficked areas. The requirements are defined with appropriate cross-reference to EN 13242.

This European Standard applies to unbound mixtures of natural, artificial and recycled aggregates with a upper sieve size (D) from 8 mm to 90 mm and lower sieve size (d) = 0 at the point of delivery.

NOTE 1 Mixtures with an upper sieve size (D) greater than 90 mm are not covered by this European Standard but may be specified in the place of use.

NOTE 2 Water content of the mixture and the density of the installed layer are not specified mixture requirements. Both parameters are related to the control of the construction of the layer and are outside the scope of this European Standard.

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 1744-1, *Tests for chemical properties of aggregates — Part 1: Chemical analysis*

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 the determination of the 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*

3 Terms and definitions

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

NOTE Other useful terms and definitions are given in EN 13242.

3.1
unbound mixture
granular material, normally of a controlled grading with d = 0, which is generally used in pavement bases and sub-bases

NOTE An unbound mixture does not contain an added binder.

3.2
category
level of a property expressed as a range of values or a limiting value

NOTE There is no relationship between the categories of different properties.

3.3
grading
particle size distribution expressed as the percentage by mass passing a specified number of sieves

3.4
batch
production quantity, delivery quantity, partial delivery quantity (railway wagon-load, lorry-load, ship's cargo) or stockpile produced at one specific time under conditions that are presumed to be uniform

NOTE With a continuous process the quantity produced during an agreed period is treated as a batch.

4 Requirements

4.1 General requirements

The need for testing for all properties in this clause shall be limited according to the particular application or end use or origin of the mixture. When required, the tests specified in 4.2 to 4.5 shall be carried out to determine appropriate properties.

NOTE When a test is not required, it should be specified as a “No requirement”.

4.2 Aggregate requirements

When required, the following properties of the aggregates used in the mixture shall be in accordance with EN 13242:

— shape of coarse aggregate;

— percentage of crushed or broken particles and of totally rounded particles in coarse aggregates;

— fines quality;

— resistance to fragmentation of coarse aggregate;

— particle density;

— water absorption;

— resistance to wear of coarse aggregate;

— chemical requirements;

— durability requirements.

4.3 Mixture requirements

4.3.1 Mixture designation

Mixtures shall be selected from Table 1.

Table 1 — Mixture designation

0/8	0/10	0/11,2	0/12,5	0/14
0/16	0/20	0/22,4	0/31,5	0/40
0/45	0/56	0/63	0/80	0/90

4.3.2 Fines content

When required, the percentage of particles which pass the 0,063 mm sieve (fines) determined in accordance with EN 933-1 shall not exceed the values in Table 2, according to the category chosen.

Table 2 — Maximum fines content

Percentage passing 0,063 mm sieve by mass	Category
≤ 3	UF_3
≤ 5	UF_5
≤ 7	UF_7
≤ 9	UF_9
≤ 12	UF_{12}
≤ 15	UF_{15}
No requirement	UF_N

When required, the percentage of particles passing the 0,063 mm sieve shall also be greater than the values given in Table 3, according to the category chosen.

Table 3 — Minimum fines content

Percentage passing 0,063 mm sieve by mass	Category
≥ 2	LF_2
≥ 4	LF_4
≥ 8	LF_8
No requirement	LF_N

The categories in Table 2 and Table 3 shall be chosen so that the difference between the maximum fines content and the minimum fines content is not less than 3 %.

4.3.3 Oversize

When determined in accordance with EN 933-1, the percentage of particles passing the upper (D) sieve shall lie within the ranges given in Table 4 according to the category chosen.

Table 4 — Oversize

Percentage passing by mass			Category
2 D[a] [b]	1,4 D[b]	D[c]	
—	100	90 to 99	OC_{90}
—	100	85 to 99	OC_{85}
100	—[d]	80 to 99	OC_{80}
100	—[e]	75 to 99	OC_{75}

[a] For aggregate sizes where D is greater than 63 mm, only the oversize requirements related to the 1,4 D sieve apply because there is no ISO 565/R20 series sieve size larger than 125 mm.

[b] Where the sieves calculated as 1,4 D and 2 D are not exact sieve numbers in the ISO 565/R20 series then the next nearest sieve size shall be adopted. When D = 90 mm the 125 mm sieve shall be used as oversize.

[c] The percentage passing sieve size D may be greater than 99 % but in such cases the supplier shall declare the typical grading.

[d] For aggregate sizes where D is smaller than 63 mm, add a range of 90 to 100 to the 1,4 *D* sieve.

[e] For aggregate sizes where D is smaller than 63 mm, add a range of 85 to 100 to the 1,4 *D* sieve.

4.4 Grading requirements

4.4.1 General grading curve

When required, the percentage by mass passing sieve *A*, sieve *B*, sieve *C*, sieve *E* and where specified in Table 6 sieve *F* and sieve *G* determined in accordance with EN 933-1 using the sieves defined in Table 5 shall be within the overall grading range appropriate to the category selected from Table 6.

Table 5 — Sieves for grading

Mixture designation	Sieve *A*	Sieve *B*	Sieve *C*	Sieve *E*	Sieve *F*	Sieve *G*
0/8	4	2	—	1	0,5	—
0/10	4	2	—	1	0,5	—
0/11,2	5,6	4	2	1	0,5	—
0/12,5	6,3	4	2	1	0,5	—
0/14	8	4	2	1	0,5	—
0/16	8	4	2	1	0,5	—
0/20	10	4	2	1	0,5	—
0/22,4	11,2	5,6	2	1	0,5	—
0/31,5	16	8	4	2	1	0,5
0/40	20	10	4	2	1	0,5
0/45	22,4	11,2	5,6	2	1	0,5
0/56	31,5	16	8	4	2	1
0/63	31,5	16	8	4	2	1
0/80	40	20	10	4	2	1
0/90	45	22,4	11,2	5,6	2	1

NOTE Table 5 does not define sieve *C* and sieve *G* for all mixtures.

In addition, for categories G_A, G_B, G_C, G_O and G_P the mean value calculated from all gradings shall be within the supplier declared value grading range appropriate to the category selected from Table 6.

Table 6 — Overall grading

Grading range	Percentage passing by mass						Category
	Sieve *A*	Sieve *B*	Sieve *C*	Sieve *E*	Sieve *F*	Sieve *G*	*G*
Normal graded mixtures							
Overall	55 to 85	35 to 65	22 to 50	15 to 40	10 to 35	0 to 20	G_A
Supplier declared value (S)	63 to 77	43 to 57	30 to 42	22 to 33	15 to 30	5 to 15	
Overall	55 to 85	35 to 68	22 to 60	16 to 47	9 to 40	5 to 35	G_B
Supplier declared value (S)	63 to 77	43 to 60	30 to 52	23 to 40	14 to 35	10 to 30	
Overall	50 to 90	30 to 75	20 to 60	13 to 45	8 to 35	5 to 25	G_C
Supplier declared value (S)	61 to 79	41 to 64	31 to 49	22 to 36	13 to 30	10 to 20	
Open graded mixtures							
Overall	50 to 78	31 to 60	18 to 46	10 to 35	6 to 26	0 to 20	G_O
Supplier declared value (S)	58 to 70	39 to 51	26 to 38	17 to 28	11 to 21	5 to 15	
Overall	43 to 81	23 to 66	12 to 53	6 to 42	3 to 32	No req.	G_P
Supplier declared value (S)	54 to 72	33 to 52	21 to 38	14 to 27	9 to 20		
Other mixtures							
Overall	50 to 90	30 to 75	15 to 60	no req.	0 to 35	No req.	G_E
Supplier declared value (S)	No requirement						
Overall	50 to 90	30 to 75	15 to 60	No requirement			G_U
Supplier declared value (S)	No requirement						
Overall	47 to 87	No requirement		15 to 75	No requirement		G_V
Supplier declared value (S)	No requirement						
Overall	No requirement						G_N
Supplier declared value (S)							

For the control of individual batches of mixtures, the supplier of categories G_A, G_B, G_C, G_O and G_P shall nominate a supplier declared value within the supplier declared value grading range appropriate to the mixture type.

NOTE Use of the supplier declared value is illustrated in Annex A.

4.4.2 Grading of individual batches

When required in addition to conforming to the overall grading range given in Table 6, the grading of at least 90 % of batches assessed over a maximum period of six months within a system of factory production control shall conform to the following requirements, to ensure that production is consistent and that the mixture has a continuous grading:

a) the percentage by mass passing each sieve shall have a value which conforms to the appropriate tolerances given in Table 7, when compared with the relevant supplier declared value.

b) the calculated difference between the values of percentage by mass passing selected sieves shall conform to the appropriate range given in Table 8.

Table 7 — Grading of individual batches — comparison with supplier declared value

Categories	Comparison with supplier declared value (S)		
	Tolerances in percentage by mass		
	Sieves *A*, *B* and *C*	Sieve *E*	Sieves *F* and *G*
G_A, G_B and G_O	± 8	± 7	± 5
G_C	± 11	± 9	± 5
G_P	± 15	± 13	± 10
G_E, G_U, G_V and G_N	No requirement		

Table 8 — Grading of individual batches — differences in values passing each sieve

Categories	Differences in values passing each sieve Percentage by mass passing sieve					
	Between *A* and *B* and between *B* and *C*		Between *C* and *E*		Between *E* and *F*	
	not more than	not less than	not more than	not less than	not more than	not less than
G_A, G_B and G_O	25	10	20	7	15	4
G_C	30	7	20	7	15	4
G_P	30	7	No requirement			
G_E	35	5	No requirement			
G_U, G_V and G_N	No requirement					

4.5 Other requirements

Under certain conditions frost susceptibility, permeability and leaching shall be considered.

NOTE 1 There is currently insufficient experience to define test methods and set specification limits which can be used in all parts of Europe. The test method may be a direct frost heave, permeability or an indirect method. The requirements may be given in regulations in the place of use.

NOTE 2 Guidance on the assessment of the mechanical behaviour of unbound mixtures is given in Annex B.

5 Evaluation of conformity

5.1 Sampling

Bulk (initial) samples of unbound mixtures shall be taken and reduced in accordance with EN 13286-1.

5.2 Factory production control

The producer shall have in place a system of factory production control that complies with the requirements of Annex C.

5.3 Declaration of laboratory dry density and optimal water content

As part of the system of factory production control a typical value of laboratory dry density and optimum water content shall be determined. The fines content of the sample used for the test shall also be reported.

The test methods used to determine laboratory dry density and optimum water content shall be selected from the methods listed below:

— Proctor compaction in accordance with EN 13286-2,

— vibrocompression with controlled parameters in accordance with EN 13286-3,

— vibrating hammer in accordance with EN 13286-4,

— vibrating table in accordance with EN 13286-5.

For categories G_A, G_B, G_C, G_O and G_P in Table 6 which are defined using supplier declared values the sample used for the test shall have a grading within ±5 % of the supplier declared value for each sieve.

5.4 Declaration of water soluble sulphate content

When required, as part of the system of factory production control the water soluble sulphate content of the mixture shall be determined using the test method set out in EN 1744-1.

NOTE National standards for the design and construction of pavements may limit the sulphate content of mixtures placed close to concrete.

6 Designation and description

The designation for mixtures shall include at least the following information:

a) reference to this European Standard;

b) source — if the mixture has been rehandled in a depot both source and depot shall be stated;

c) aggregate size — value of upper sieve (D) size;

d) type(s) of aggregate used in the mixture.

The following additional information shall also be supplied by the supplier if requested at the time that the order is placed to suit the end use of the mixture:

e) declared laboratory dry density of the mixture (5.3) and the test method used for the determination;

f) declared water soluble sulphate content (5.4);

g) information about the aggregates used in the mixture as described in EN 13242.

7 Marking and labelling

The delivery ticket shall contain at least the following information:

a) designation;

b) date of dispatch and origin;

c) quantity (mass);

d) serial number of ticket.

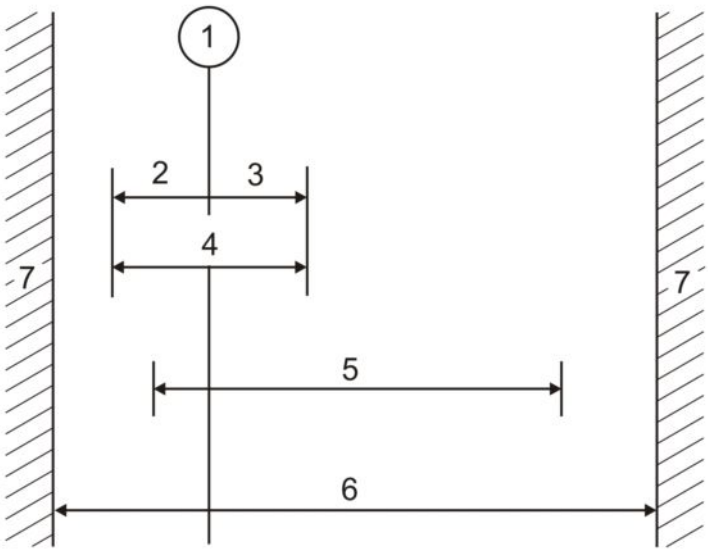
NOTE It may be a requirement of the supply agreement to have additional information on the delivery ticket.

Annex A
(informative)

Use of the supplier declared value

A.1 Terminology

Figure A.1 illustrates the terminology used in 4.4.1 to control the grading of individual batches of mixture.



Key
1 Supplier declared value
2 Negative tolerance
3 Positive tolerance
4 Supplier typical grading range
5 Supplier declared value grading range
6 Overall grading range
7 Not permitted

Figure A.1 — Use of the supplier declared value

A.2 Overall grading range

The results of all grading tests should conform to the overall grading range appropriate to the categories in Table 6.

A.3 Supplier declared value grading range

The mean value calculated from the results of all grading tests should conform to the supplier declared value grading range appropriate to the categories in Table 6. A supplier declared value grading range is not specified for categories G_E and G_U.

A.4 Supplier declared value

The supplier declared value is nominated by the supplier to provide a local specification for the control of individual batches of a mixture. The supplier declared value lies within the supplier declared value grading range appropriate to the categories. A supplier declared value is not required for categories G_E, G_U and G_V.

A.5 Tolerances for comparison with the supplier declared value

At least 90 % of batches assessed over a maximum period of six months should have a grading which conforms to the appropriate tolerances given in Table 7, when compared with the relevant supplier declared value. The application of a tolerance should not be used to accept a value outside the appropriate overall grading range described in A.2.

Annex B
(informative)

Guidance on the assessment of the mechanical behaviour of unbound mixtures

The cyclic load triaxial test provides a method for defining the mechanical properties of an unbound mixture. The test has been developed in a number of countries.

The method is defined in EN 13286-7. Use of the test method will develop experience and knowledge of appropriate compliance criteria which may be included in future revisions of this European Standard.

For the purposes of classification of materials and design of pavement structures, it is necessary to characterize the mechanical behaviour of unbound mixtures as to their:

— stiffness (resilient behaviour), measured by Young's modulus, calculated for a conventional stress level;

— sensitivity to permanent strains, derived at the end of conditioning.

Both properties can be assessed using the cyclic load triaxial test. The conditions of the test may be close to those found in-situ, especially for water content and density. The different types of cyclic triaxial tests are defined in EN 13286-7.

Annex C
(normative)

Factory production control

C.1 Introduction

This annex specifies a factory production control system for unbound mixtures to ensure that they conform to the relevant requirements of this European Standard.

The performance of the factory production control system shall be assessed according to the principles set out in this annex.

C.2 Organization

C.2.1 Responsibility and authority

The responsibility, authority and the interrelation between all personnel who manage, perform and verify work affecting quality shall be defined, including personnel who need organizational freedom and authority to:

a) initiate action to prevent occurrence of product non-conformity;

b) identify, record and deal with any product quality deviations.

C.2.2 Management representative for factory production control

For every plant producing unbound mixtures, the producer shall appoint a person with appropriate authority to ensure that the requirements of this annex are implemented and maintained.

C.2.3 Management review

The factory production control system adopted to satisfy the requirements of this annex shall be audited and reviewed at appropriate intervals by management to ensure its continuing suitability and effectiveness. Records of such reviews shall be maintained.

C.3 Control procedures

C.3.1 General

The producer shall establish and maintain a production control manual setting out the procedures by which the requirements for factory production control are satisfied.

C.3.2 Document and data control

Document and data control shall include those documents and data that are relevant to the requirements of this standard covering purchasing, processing, inspection of materials and the factory production control system documents.

A procedure concerning the management of documents and data shall be documented in the production control manual covering procedures and responsibilities for approval, issue, distribution and administration of internal and external documentation and data; and the preparation, issue and recording of changes to documentation.

C.3.3 Sub-contract services

If any part of the operation is sub-contracted by the producer, a means of control shall be established.

The producer shall reform overall responsibility for any parts of the operation sub-contracted.

C.3.4 Knowledge of mixture components

There shall be documentation detailing the source and type of each of the mixture components available for use at the production location.

It is the producer's responsibility to ensure that if any dangerous substances are identified, their contents do not exceed the limits in force according to the provisions valid in the place of use of unbound mixture.

C.4 Management of the production

The factory production control system shall fulfil the following requirements:

a) There shall be procedures to identify and control the materials.

NOTE These may include procedures for maintaining and adjusting processing equipment, inspection or testing material sampled during processing, modifying the process during bad weather, etc.

b) There shall be procedures to identify and control any hazardous materials identified in C.3.3 to ensure that they do not exceed the limits in force according to the provisions valid in the place of use of the aggregate.

c) There shall be procedures to ensure that material is put into stock in a controlled manner and the storage locations and their contents are identified.

d) There shall be procedures to ensure that material taken from stock has not deteriorated in such a way that its conformity is compromised.

e) The product shall be identifiable up to the point of sale as regards source and type.

C.5 Inspection and test

C.5.1 General

The producer shall make available all the necessary facilities, equipment and trained personnel to carry out the required inspections and tests.

C.5.2 Equipment

The producer shall be responsible for the control, calibration and maintenance of the inspection, measuring and test equipment.

Accuracy and frequency of calibration in accordance with the relevant test methods.

Equipment shall be used in accordance with documented procedures.

Equipment shall be uniquely identified. Calibration records shall be retained.

C.5.3 Frequency and location of inspections, sampling and tests

The factory production control document shall describe the frequency and nature of inspections.

The frequency of sampling and the tests when required shall be carried out for the relevant characteristic as specified in Table C.1.

NOTE 1 Test frequencies are generally related to periods of production. A period of production is defined as a full week, month or year of production working days.

NOTE 2 The requirements for factory production control may introduce visual inspection. Any deviations indicated by these inspections may lead to increased test frequencies.

NOTE 3 When the measured value is close to a specified limit the frequency may need to be increased.

NOTE 4 Under special conditions the test frequencies may be decreased below those given in Table C.1. These conditions could be:

a) highly automated production equipment;

b) long-term experience with consistency of special properties;

c) sources of high conformity;

d) running a Quality Management System with exceptional measures for surveillance and monitoring of the production process.

The producer shall prepare a schedule of test frequencies taking into account the minimum requirements of Table C.1.

Reasons for decreasing the test frequencies shall be stated in the factory production control document.

Table C.1 — Minimum test frequencies for unbound mixtures

Aggregate property	Clause	Notes	Test method	Minimum test frequency
Aggregate requirements	4.2	In accordance with EN 13242.	—	—
Fines content	4.3		EN 933-1	1 per week
Grading	4.4	Compliance with the various criteria is assessed to suit the categories required by current purchaser specifications	EN 933-1	1 per week or 1 per 5 000 t (whichever is most frequent)
Laboratory dry density, optimum water content	5.3			1 per year
Water soluble sulphate content	5.4		EN 1744-1	1 per year
Frost susceptibility	4.5		—	—
Permeability			—	—
Leaching			—	—

C.6 Records

The results of factory production control shall be recorded including sampling locations, dates and times and product tested with any other relevant information, e.g. weather conditions.

NOTE 1 Some characteristics may be shared by several products, in which case the producer, based on his experience, may find it possible to apply the results of one test to more than one product. This is particularly the case when a product is the combination of two or more different sizes. The intrinsic characteristics may not change but the particle size distribution or the cleanliness should be checked.

Where the product inspected or tested does not satisfy the declared value, or if there is an indication that it shall not do so, a note shall be made in the records of the steps taken to deal with the situation (e.g. carrying out of a new test and/or measures to correct the production process).

The records required by all the clauses of this annex shall be included.

The records shall be kept for at least the statutory period.

NOTE 2 "Statutory period" is the period of time records are required to be kept in accordance with Regulations applying at the place of production.

C.7 Control of non-conforming product

Following an inspection or test which indicates that a product does not conform the affected material shall be:

a) reprocessed; or

b) diverted to another application for which it is suitable; or

c) rejected and marked as non-conforming.

All cases of non-conformity shall be recorded by the producer, investigated and if necessary corrective action shall be taken.

NOTE Corrective actions can include:

a) investigation of the cause of the non-conformity, including examination of the testing procedure and making any necessary adjustments;

b) analysis of processes, operations, quality records, service reports and customer complaints to detect and eliminate potential causes of non-conformity;

c) initiating of preventive action to deal with problems to a level corresponding to the risks encountered;

d) applying controls to ensure that effective corrective actions are taken;

e) implementing and recording changes in procedures resulting from corrective action.

C.8 Handling, storage and conditioning in production areas

The producer shall make the necessary arrangement to maintain the quality of the product during handling and storage.

NOTE These arrangements should take account of the following:

a) contamination of product;

b) segregation;

c) cleanliness and handling equipment and stocking areas.

C.9 Transport and packaging

C.9.1 Transport

The producer's factory production control system shall identify the extent of his responsibility in relation to storage and delivery.

NOTE When mixtures are transported in bulk it may be necessary to cover or contain mixtures to reduce contamination.

C.9.2 Packaging

If a mixture is packaged the methods and materials used shall not contaminate and degrade the mixture to the extent that the properties are significantly changed before the mixture is removed from the packaging. Any precautions necessary to achieve this during handling and storage of the packaged aggregate shall be marked on the packaging or accompanying documents.

C.10 Training of personnel

The producer shall establish and maintain procedures for the training of all personnel involved in the production system. Appropriate records of training shall be maintained.

Bibliography

[1] EN 13286-7:2004, *Unbound and hydraulically bound mixtures — Part 7: Cyclic load triaxial test for unbound mixtures*

[2] ISO 565:1990, *Test sieves — Metal wire cloth, perforated metal plate and electroformed sheet — Nominal sizes of openings*

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