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# Hydraulically bound mixtures — Specifications —

## Part 11: Soil treated by lime

The European Standard EN 14227-11:2006 has the status of a  
British Standard

ICS 93.080.20





## National foreword

This British Standard is the official English language version of EN 14227-11:2006.

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

## Hydraulically bound mixtures - Specifications - Part 11: Soil treated by lime

Mélanges traités aux liants hydrauliques - Spécifications -  
Partie 11: Sol traité à la chaux

Hydraulisch gebundene Gemische - Anforderungen - Teil  
11: Bodenverbesserung mit Kalk

This European Standard was approved by CEN on 3 February 2006.

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 Central Secretariat 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 Central Secretariat has the same status as the official versions.

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EUROPEAN COMMITTEE FOR STANDARDIZATION  
COMITÉ EUROPÉEN DE NORMALISATION  
EUROPÄISCHES KOMITEE FÜR NORMUNG

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## Foreword

This European Standard (EN 14227-11:2006) 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 2006, and conflicting national standards shall be withdrawn at the latest by November 2006.

This European Standard is one of a series of standards for hydraulically bound mixtures:

EN 14227-1, *Hydraulically bound mixtures — Specifications — Part 1: Cement bound granular mixtures.*

EN 14227-2, *Hydraulically bound mixtures — Specifications — Part 2: Slag bound mixtures.*

EN 14227-3, *Hydraulically bound mixtures — Specifications — Part 3: Fly ash bound mixtures.*

EN 14227-4, *Hydraulically bound mixtures — Specifications — Part 4: Fly ash for hydraulically bound mixtures.*

EN 14227-5, *Hydraulically bound mixtures — Specifications — Part 5: Hydraulic road binder bound mixtures.*

EN 14227-10, *Hydraulically bound mixtures — Specifications — Part 10: Soil treated by cement.*

EN 14227-11, *Hydraulically bound mixtures — Specifications — Part 11: Soil treated by lime.*

EN 14227-12, *Hydraulically bound mixtures — Specifications — Part 12: Soil treated by slag.*

EN 14227-13, *Hydraulically bound mixtures — Specifications — Part 13: Soil treated by hydraulic road binder.*

EN 14227-14, *Hydraulically bound mixtures — Specifications — Part 14: Soil treated by fly ash.*

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, 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 United Kingdom.

## 1 Scope

This European Standard applies to the treatment with lime of natural soils and other materials for roads, airfields and other trafficked areas and specifies the requirements for their constituents, composition and laboratory performance classification.

Two types of treatment are covered, improvement and stabilization.

This European Standard relates only to lime-treated layers for trafficked areas (as opposed to lime columns or piles for example) but can be used for other civil engineering purposes although additional requirements might be necessary to complement or replace those required by this European Standard.

## 2 Normative references

The following referenced documents are indispensable for the application of this European Standard. 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 459-2, *Building lime — Part 2: Test methods*

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

## 3 Terms and definitions

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

### 3.1

#### lime

air lime

### 3.2

#### soil

natural, artificial or recycled material or any combination of these



# EN 14227-11:2006 (E)

## 3.3

### soil treated by lime

mixture resulting from the addition of lime to a soil in order that it can fulfil its intended purpose

NOTE Treatment encompasses both improvement and stabilization.

## 3.4

### soil improved by lime

mixture resulting from the treatment of a soil with lime which improves immediate performance by, for example, either a reduction in moisture content, and/or enhancement of bearing capacity, and/or reduction in plasticity, to enable the soil to provide one or more of the following:

ability to be handled by conventional earthmoving equipment;

ability to be satisfactorily compacted in layers;

ability to be trafficked and provide a working platform for the superimposed layer;

preparation of a soil for the subsequent treatment by slag, fly ash, cement, hydraulic road binder or other product

## 3.5

### soil stabilized by lime

mixture resulting from the treatment of a soil with lime that significantly enhances, generally in the medium to long-term, its mechanical performance and stability, particularly with respect to the action of water and frost

## 4 Constituents

### 4.1 Lime

Lime shall be quick lime or hydrated lime.

NOTE Hydrated lime may be used dry or in slurry form.

#### 4.1.1 Quick lime

Quick lime shall conform to EN 459-1, class CL 90 or CL 80, and the following.

When tested in accordance with EN 459-2, the particle size of the quick lime shall conform to the selected category from Table 1.

Table 1 — Particle size categories for quick lime		
Sieve size		
mm	Category 1	Category 2
10	100	100
5	100	≥ 95
2	≥ 95	—
0,2	≥ 70	—
0,09	≥ 50	—



When tested in accordance with the reactivity test in EN 459-2, the quick lime shall attain a temperature of 60 °C within 25 min.

NOTE 1 In the case of quick limes containing material greater than 2 mm in size, the proportion retained on the 2 mm sieve should be ground down to finer than 2 mm for inclusion in the test.

The mixing process shall ensure that full slaking of the quick lime occurs prior to final compaction.

NOTE 2 In the case of category 1 particle size and provided sufficient water is present, full slaking is normally possible after just one mixing stage. In the case of category 2, full slaking, again provided sufficient water is present, may require 2 or more mixing stages separated by a period of at least 24 h.

#### **4.1.2 Hydrated lime**

Hydrated lime shall conform to EN 459-1, class CL 90 or CL 80.

#### **4.2 Water**

The water used shall not adversely affect the performance of the mixture.

#### **4.3 Soil**

##### **4.3.1 Soil for improvement by lime**

The soil shall be suitable for treatment using common processes and equipment.

NOTE There are no physical requirements for soil prior to improvement other than the practical limits set by the capabilities of the mixer for the improvement operation, although the presence of sulfates or other substances with the potential for disruption by swelling may require investigation using testing in accordance with this European Standard.

##### **4.3.2 Soil for stabilization by lime**

The soil shall not contain sulfates or other potentially disruptive material that, after lime addition, result in swelling of the mixture in excess of that allowed by Clause 6.

NOTE 1 There are no absolute requirements for the grading or plasticity of soil prior to stabilization but guidance is given in Annex A.

NOTE 2 Laboratory mixture design work will determine whether soil containing organic matter can be accommodated. The amount of organic matter that can be accommodated depends on its type.

### **5 Laboratory performance for soil improved by lime**

#### **5.1 General**

Soil improved by lime shall conform to one of the categories in either 5.2, 5.3 or 5.4 for immediate bearing index, moisture condition value and degree of compaction respectively.

#### **5.2 Immediate bearing index**

When required, the immediate bearing index of the mixture at the declared water content shall conform to one of the classes in Table 2 observing the following testing procedure. After mixing, the mixture shall be stored in bags in a sealed condition for 60 min. The specimen(s) shall then be manufactured and the determination of the index carried out immediately or no later than 90 min after mixing.

Table 2 — Immediate bearing index

Immediate bearing index	Category
$\geq 5$	IPI <sub>5</sub>
$\geq 7$	IPI <sub>7</sub>
$\geq 10$	IPI <sub>10</sub>
$\geq 15$	IPI <sub>15</sub>
$\geq 20$	IPI <sub>20</sub>
$\geq 25$	IPI <sub>25</sub>
Declared value	IPI <sub>DV</sub>

### 5.3 Moisture condition value

The moisture condition value of the mixture, determined in accordance with EN 13286-46, shall conform to the selected category from Table 3.

Table 3 — Moisture condition value

Moisture condition value	Category
8 minimum, 12 maximum	MCV <sub>8/12</sub>
Declared values	MCV <sub>DV</sub>

NOTE The moisture condition value test is particularly suitable for cohesive soils.

### 5.4 Degree of compaction

The degree of compaction of the mixture shall conform to the selected category from Table 4.

Table 4 — Degree of compaction

The ratio in % of the in situ dry density to the Proctor (see NOTE) dry density determined in accordance with EN 13286-2	Category
$\geq 95$	DC <sub>95</sub>
$\geq 97$	DC <sub>97</sub>
Declared value	DC <sub>DV</sub>

NOTE Proctor refers to an energy level of approximately 0,6 MJ/m<sup>3</sup> conforming to EN 13286-2.

### 5.5 Swelling

Depending on the application, the swelling of the mixture shall be examined using either volumetric swelling or linear swelling described in 6.6.

NOTE In the case of examination using linear swelling, the specified limits in 6.6, which relate to lime – stabilized mixture, may require modification to suit the application of the lime-improved mixture.

## 6 Laboratory performance for soil stabilized by lime

### 6.1 Degree of pulverization

When required, the degree of pulverization of the mixture, determined in accordance with EN 13286-48, shall conform to the selected category of Table 5.

**Table 5 — Degree of pulverization**

Degree of pulverization	Category
≥ 30 %	P <sub>30</sub>
≥ 40 %	P <sub>40</sub>
≥ 50 %	P <sub>50</sub>
≥ 60 %	P <sub>60</sub>
Declared value	P <sub>DV</sub>

### 6.2 Water content

When required, the water content of the mixture shall conform to the selected category from Table 6.

**Table 6 — Water content**

Minimum water content of the mixture	Category
0,9 optimum water content of the mixture determined in accordance with Proctor compaction in EN 13286-2	W <sub>0,9</sub>
The optimum water content of the mixture determined in accordance with Proctor compaction in EN 13286-2	W <sub>1,0</sub>
Declared value	W <sub>DV</sub>

NOTE Proctor refers to an energy level of approximately 0,6 MJ/m<sup>3</sup> conforming to EN 13286-2.

### 6.3 Immediate bearing index

When required, the immediate bearing index of the mixture at the declared water content shall conform to one of the categories in Table 7 observing the following testing procedure. After mixing, the mixture shall be stored in bags in a sealed condition for 60 min. The specimen(s) shall then be manufactured and the determination of the index carried out immediately or no later than 90 min after mixing.

**Table 7 — Immediate bearing index**

Immediate bearing index	Category
≥ 10	IPI <sub>10</sub>
≥ 15	IPI <sub>15</sub>
≥ 20	IPI <sub>20</sub>
≥ 25	IPI <sub>25</sub>
Declared value	IPI <sub>DV</sub>

**6.4 Moisture condition value**

When required, the moisture condition value of the mixture, determined in accordance with EN 13286-46, shall conform to the selected category from Table 8.

**Table 8 — Moisture condition value**

Moisture condition value	Category
6 minimum, 10 maximum	MCV <sub>6/10</sub>
7 minimum, 11 maximum	MCV <sub>7/11</sub>
8 minimum, 12 maximum	MCV <sub>8/12</sub>
9 minimum, 13 maximum	MCV <sub>9/13</sub>
Declared value	MCV <sub>DV</sub>

**6.5 Mechanical performance**

**6.5.1 General**

Lime stabilized mixtures shall satisfy the requirements of one of the categories for either California bearing ratio or compressive strength below.

NOTE No correlation is intended nor should be assumed between the two methods.

**6.5.2 California bearing ratio**

The California bearing ratio of the mixture, determined in accordance with EN 13286-47 and the following, shall conform to the selected category from Table 9.

- a) After manufacture, the specimens shall be subjected to a conditioning period of either 1 h, 3 days, or other selected period during which time, the specimens shall be prevented from drying out and shall be maintained at a temperature of (20 ± 2) °C or other specified temperature.
- b) After conditioning, the test specimens shall undergo a soaking period of either 4 days or other longer period before testing, during which they shall be maintained at a temperature of (20 ± 2) °C or other specified temperature.
- c) The length of conditioning and soaking periods shall be noted in the test report.

Table 9 — California bearing ratio categories for soil stabilized by lime

CBR requirement after 4 days soaking (or other longer specified period)	Class
≥ 15	CBR <sub>15</sub>
≥ 20 and not less than the immediate bearing index	CBR <sub>20</sub>
≥ 30 and not less than the immediate bearing index	CBR <sub>30</sub>
≥ 40 and not less than the immediate bearing index	CBR <sub>40</sub>
≥ 50 and not less than the immediate bearing index	CBR <sub>50</sub>
Declared value (but not less than 15)	CBR <sub>DV</sub>

### 6.5.3 Compressive strength

The compressive strength of the mixture, determined in accordance with EN 13286-41 on specimens manufactured in accordance with EN 13286-50, after a conditioning period of freeze thaw cycles or other specified conditioning, shall conform to the selected class from Table 10.

Freeze thaw cycling shall be carried out in accordance with regulation at the place of use. The type, extent and duration of conditioning shall be reported.

NOTE There is currently insufficient experience to define a method of freeze thaw conditioning that can be used in all parts of Europe.

Table 10 — Compressive strength for soil stabilized by lime

Compressive strength	Class
≥ 0,2 MPa	R <sub>c</sub> 0,2
≥ 0,5 MPa	R <sub>c</sub> 0,5
≥ 1,0 MPa	R <sub>c</sub> 1,0
Other declared value but not less than 0,2 MPa	R <sub>c</sub> DV

## 6.6 Swelling

### 6.6.1 General

Swelling shall be examined in accordance with either 6.6.2 or 6.6.3.

NOTE In the case of mechanical performance characterization by compressive strength to the requirements of this European Standard, experience indicates that the mixture is usually satisfactory provided the selected compressive strength requirement from Table 10, after 12 freeze/thaw cycles, is satisfied, but this should be verified in the place of use.

### 6.6.2 Linear swelling after soaking in water

Linear swelling, determined on at least 3 fully soaked (immersed) CBR specimens in accordance with EN 13286-47, using water that is continuously aerated, shall conform to the selected category from Table 11. Soaking shall follow a conditioning period. Swelling shall be examined for at least 28 days or until swelling ceases if longer.

NOTE The conditioning period will usually be the same as that selected for the determination of CBR in 6.5.2.

Table 11 — Linear swelling

Average maximum swelling of the specimens mm	Maximum swelling of any individual specimen mm	Classes
5	10	LS <sub>5</sub>
3	6	LS <sub>3</sub>
1	2	LS <sub>1</sub>

### 6.6.3 Volumetric swelling

Volumetric swelling  $G_v$  shall not exceed 5 % when tested in accordance with EN 13286-49.

NOTE Where the volumetric swelling is greater than 5 % but does not exceed 10 %, the use of the mixture is generally not possible; however a complementary study can be made according to experience at the place of use.

### 6.7 Frost resistance

Frost resistance shall be examined in accordance with provisions valid in the place of use.

NOTE There is currently insufficient experience to define a method for frost resistance that can be used in all parts of Europe.

## 7 Production control

See informative Annex B.

## 8 Designation and description

8.1 The product shall be designated by:

- producer, place of production and producer code;
- reference to this European Standard, i.e. EN 14227-11;
- mixture type and mechanical performance characterization (e.g. soil improved by lime – IPI<sub>15</sub>, soil stabilized by lime – CBR<sub>15</sub>).

8.2 In addition, the product shall be described by:

- description of the constituents;
- mixture proportions including water content;
- for stabilized soil, the selected category of pulverization, water content, immediate bearing index, moisture condition value, the mechanical performance values including the method and energy of specimen manufacture, curing conditions, curing period, testing, dry density and water content of the mechanical performance specimens as appropriate;
- swelling data and, if appropriate, frost resistance data.

## 9 Marking and labelling

When appropriate, the delivery ticket shall contain at least the following:

- a) designation;
- b) date of despatch;
- c) quantity;
- d) serial number.

## Annex A

(informative)

### Grading and plasticity guidance for soil for stabilization

**Table A.1 — Grading and plasticity guidance**

Characteristic	Advice	Comments
D95 (95 % of soil finer than)	Preferably < 63 mm	It is a function of the type of material being treated and the type and power of the mixing unit.
Passing 63 micron	Preferably > 12 %	To ensure sufficient material for stabilization with lime. Where such material is lacking, siliceous fly ash may be added.
Plasticity index	Preferably > 5	For effective stabilization, reactive clay needs to be present in sufficient quantities. Thus the plasticity index of the soil should be measurable and greater than 5. It should be noted that some clays are more reactive than others and that specifying a minimum plasticity index does

not guarantee effective stabilization. As above the addition of siliceous fly ash may be beneficial.



## **Annex B**

### (informative)

## **Production control for hydraulically treated mixtures**

### **B.1 General**

This annex describes the recommendations for a production control system for producers of hydraulically treated mixtures (e.g. aggregates and soils treated by lime, hydraulic binders or hydraulic combinations).

The objective of production control is to give assurance that the mixture conforms to the specification.

### **B.2 Quality Manual**

The producer should establish and maintain his policy and procedures for production control in a Quality Manual that should include:

- producer's organizational structure relating to quality;
- control of constituents and mixtures;
- process control, calibration and maintenance;
- requirements for handling and storage of the mixture when appropriate;
- inspection, calibration and control of the measuring equipment in the process, and laboratory testing equipment for the mixture;
- procedures for handling non-conforming mixture.

### **B.3 Organization**

#### **B.3.1 Responsibility and authority**

The responsibility, authority and inter-relation of all personnel who manage, perform and verify work affecting quality should be defined in the Quality Manual, particularly personnel who have authority to identify, record and rectify any mixture quality problems.

#### **B.3.2 Management representative**

The producer should appoint a person with appropriate authority, knowledge and experience of production control to ensure that the requirements of the Quality Manual are implemented and maintained.

### **B.3.3 Internal audits**

The producer should carry out internal quality audits to verify compliance with the planned arrangements and the effectiveness of the quality system. Audits should be scheduled on the basis of the status and importance of the activity. The audits and follow up action should be carried out in accordance with documented procedures. The results of the audits should be documented and brought to the attention of the personnel having responsibility in the area audited. The management personnel responsible for the area should take timely corrective action on the deficiencies found by the audit and should keep a record of the action taken.

### **B.3.4 Management review**

The production control system should be reviewed at appropriate intervals by management to ensure its continuing suitability and effectiveness. Records of such reviews should be maintained.

### **B.3.5 Sub-contract services**

Where any services are supplied from outside the producer's resources, means of control should be established.

### **B.3.6 Records**

The production control system should contain adequately documented procedures and instructions.

The intended frequencies of tests and inspections by the producer should be documented and the results of tests and inspections recorded.

Sampling location, date and time, as well as details of the mixture or constituents tested, should be recorded together with any other relevant information.

Where the constituent or mixture examined does not satisfy the requirements of the appropriate specification and this European Standard, records should be kept of corrective actions taken to ensure the quality of the mixture is maintained.

Records should be kept in such a way that they are retrievable and be retained for the period stated in the Quality Manual, usually a minimum of 3 years or longer if legally required.

### **B.3.7 Training**

The producer should establish and maintain procedures for the training of all personnel involved in activities affecting quality. Personnel performing specific assigned tasks should be suitably qualified on the basis of appropriate education, training or experience, as required. Training records should be kept.

## **B.4 Control procedures**

### **B.4.1 Production management**

The production control system should contain the following:

- a) composition of the mixture to be produced;
- b) procedures to adjust mixture composition;
- c) procedures to ensure that constituents comply with requirements;

- d) procedures to ensure that production equipment, including mixture storage facilities, maintain the composition, homogeneity, and consistency of the mixture;
- e) procedures for:
- calibrating, maintaining and adjusting the process and testing equipment,
  - sampling the constituents and mixture,
  - data recording during processing,
  - adjusting the process according to weather conditions;
- f) instructions so that the mixture is identifiable up to the point of delivery as regards source and type.

#### **B.4.2 Composition of the mixture**

The composition of the mixtures should be established from a laboratory mixture design procedure intended to ensure the mixture should have properties conforming to the relevant standard.

Where applicable, the composition of regularly produced mixtures will be included in a catalogue of mixtures compositions and considered as the mixture base line or target composition.

The compositions should be re-established in case of significant change in constituents and should be reviewed periodically to ensure the mixture conforms to requirements taking account any change in properties of constituents.

#### **B.4.3 Constituents**

Documentation should detail the source and type of each constituent of the mixture for use at the production location.

Adequate supplies of constituent should be available to ensure that the planned rates of production and delivery can be maintained.

The specifications for incoming constituents should be established and communicated to suppliers by means of written orders.

The control procedures should check that constituents are capable of providing the required quality.

Constituents should be transported and stored in such a manner as to avoid intermingling, contamination or deterioration that may affect the quality of the product.

#### **B.4.4 Process control**

The Quality Manual should include:

- description of equipment and installation;
- description of the flow of constituents and the processes carried out on them. If appropriate this should incorporate a flow diagram;
- schedule for monitoring the performance of the process, (manual or automatic systems), including a record of equipment performance against the stated tolerances.

#### **B.4.5 Inspection, calibration and control of process equipment**

The Quality Manual should identify items of measuring devices that require calibration and the frequency of such calibration.

Calibration procedures should be provided, including the permitted tolerances for the devices to remain in service. The Quality Manual should state the required accuracy of all calibrations.

The equipment should be adequately maintained to ensure that it continues to be capable of producing mixture to the required specifications and tolerances.

#### **B.4.6 Handling and delivery**

The Quality Manual should contain procedures to ensure that the mixture is handled and (where appropriate) delivered with the minimum of segregation or degradation and within the permitted water content range and time limit.

At the point of delivery, the mixture should be identifiable and traceable with regard to its production data. The producer should maintain records of relevant data of production, which can be referenced from information when appropriate on the delivery ticket.

If appropriate the producer's Quality Manual should describe the characteristics of any mixture storage system and define its mode of operation. The producer should ensure through checks, inspections and records that such systems are used correctly and that mixtures maintain their suitability for use.

### **B.5 Inspection and testing of constituents and mixtures during production**

#### **B.5.1 General**

At the start of the production process, the homogeneity of the mixture should be considered with regard to the specification, the type and quality of the production plant and the quality and homogeneity of the constituents. This can be appreciated either from past production experience or by undertaking specific tests.

The Quality Manual should specify the frequency and nature of regular tests/checks/inspections that should be carried out during production. The producer should prepare a schedule of frequencies considering:

- test frequencies in relation to periods of actual production of each mixture;
- test frequency where automated surveillance and monitoring of the production process exists;
- statistical approach for testing.

Reasons for changing the test frequencies and analysis should be stated in the Quality Manual.

**NOTE** If appropriate, long-term experience of the consistency of a particular property as well as mixtures with an established record for conformity should be taken into account.

#### **B.5.2 Characteristics that require control during production**

These may include:

- properties of the constituents including water content (before production);
- proportioning of the constituents including added water;

grading of the fresh mixture;

water content of the fresh mixture.

The above characteristics should comply with the requirements of the target composition of the mixture (B.4.2).

### **B.5.3 Frequency of sampling the mixture**

During the regular production of the mixture, the sample frequency may be as follows:

In the case of plants with a validated and accepted automated surveillance and data collection system giving computerized composition for every truck or every batch, one sample should be taken every 2 000 t or 1 000 m<sup>3</sup> or one per day for lesser quantities.

In the case of other types of plants or production, one sample should be taken every 300 t or 150 m<sup>3</sup>, with a minimum of 1 sample per day.

Alternatively and independent of the type of mixing plant, the frequency of sampling can be on a time related rather than a quantity related basis such as a minimum of 1 sample per week or 1 sample per day depending on the characteristic being measured.

In the case of occasional production of a standard mixture, the production should be assessed cumulatively with previous production with the same or similar criteria. The frequency of sampling can be adjusted on a contract-by-contract basis according to the overall quantity of production required.

## **B.6 Inspection and testing equipment**

### **B.6.1 General**

All necessary facilities, equipment and personnel should be available to carry out the required inspections and tests.

Normally the testing should be performed according to the specified test methods given in the relevant standard.

Other test methods may be used, if correlations or safe relationships between the results of these test methods and the reference methods have been established.

### **B.6.2 Measuring and testing equipment**

The producer should be responsible for the control, calibration and maintenance of his inspection, measuring and testing equipment.

### **B.6.3 Measuring and testing equipment in the process**

The points in the process where measuring equipment needs to be deployed should be stated in the Quality Manual.

The quality manual should indicate when control is carried out automatically or manually. There should be a description of how equipment is maintained and calibrated.

#### **B.6.4 Measuring and testing equipment in laboratory**

The testing equipment should be in a known state of calibration and accuracy, consistent with the required measurement capability.

The following points should be addressed:

- accuracy and frequency of calibration, which should be in accordance with the standard(s) for the relevant test(s);

- equipment to be used in accordance with documented procedures;

- equipment to be uniquely identified and calibration records should be retained;

- keeping of calibration records.

### **B.7 Non-conformity**

#### **B.7.1 General**

Non-conformity can arise at the following stages:

- constituent delivery;

- constituent in storage;

- mixture production;

- handling, storage and delivery of the mixture if appropriate.

In the event that a non-conforming constituent, process or mixture is identified, investigations should be initiated to determine the reasons for non-conformity and effective corrective action should be implemented to prevent recurrence in accordance with procedures documented in the Quality Manual.

#### **B.7.2 Non-conformity of constituents**

In the case of non-conforming constituents, corrective action may involve:

- reclassifying the constituent;

- reprocessing;

- adjusting process control to allow for constituent non-conformity;

- rejection and disposal of the non-conforming constituent.

#### **B.7.3 Non-conformity of the mixture**

Non-conforming mixture should be evaluated and procedures for taking action should be followed.

The Quality Manual should identify the action to be taken when a non-conforming product is identified and should state the circumstances under which the customer will be notified of non-conforming results.

Such action may involve:

corrective action (for example modification of the mixture and or adjustment of equipment);

acceptance of the mixture following the agreement of the customer to accept a non-conforming mixture;

if the mixture produced is incorrect it can be redirect to an alternative customer if appropriate;

rejection of the mixture.

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