BS EN 15564:2008

Precast concrete products — Resin bound concrete — Requirements and test methods

ICS 91.100.30

National foreword

This British Standard is the UK implementation of EN 15564:2008.

The UK participation in its preparation was entrusted to Technical Committee B/524, Precast concrete products.

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.

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 December 2008

ISBN 978 0 580 57650 8

Amendments/corrigenda issued since publication

Date	Comments

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 15564

October 2008

ICS 91.100.30

English Version

Precast concrete products - Resin bound concrete - Requirements and test methods

Produits préfabriqués en béton - Béton de résine - Prescriptions et méthodes d'essai

Betonfertigteile - Kunstharzbeton - Anforderungen und Prüfverfahren

This European Standard was approved by CEN on 13 September 2008.

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 CEN 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 CEN Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, 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.

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

Management Centre: rue de Stassart, 36 B-1050 Brussels

Ref. No. EN 15564:2008: E

Contents

Page

Foreword

This document (EN 15564:2008) has been prepared by Technical Committee CEN/TC 229 “Precast concrete products”, the secretariat of which is held by AFNOR.

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 April 2009, and conflicting national standards shall be withdrawn at the latest by April 2009.

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.

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, 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 common requirements for resin-bound concrete used in the fabrication of precast concrete products. It is intended to be used when preparing documents for resin-bound concrete products.

Resin-bound concrete product standards will define specific requirements, which may be additional to those given in this document. Product standards will give any limiting values.

Examples for the use of resin-bound concrete are: street furniture and garden products, decorative elements, window sills, machine tool structures, elements for fence, animal troughs and slats, etc.

This standard is not applicable to polymer-modified or impregnated mortar and concrete (only PC not PCC or SPCC).

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 933-10, *Tests for geometrical properties of aggregates — Part 10: Assessment of fines — Grading of fillers (air jet sieving)*

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

EN 12620, *Aggregates for concrete*

EN 12664, *Thermal performance of building materials and products — Determination of thermal resistance by means of guarded hot plate and heat flow meter methods — Dry and moist products of medium and low thermal resistance*

EN 13501-1, *Fire classification of construction products and building elements — Part 1: Classification using data from reaction to fire tests*

EN 13823, *Reaction to fire tests for building products — Building products excluding floorings exposed to the thermal attack by a single burning item*

EN 14231, *Natural stone test methods — Determination of the slip resistance by means of the pendulum tester*

EN 14617-1, *Agglomerated stone — Test methods — Part 1: Determination of apparent density and water absorption*

EN 14617-2, *Agglomerated stone — Test methods — Part 2: Determination of flexural strength (bending)*

EN 14617-4, *Agglomerated stone — Test methods — Part 4: Determination of the abrasion resistance*

EN 14617-5, *Agglomerated stone — Test methods — Part 5: Determination of freeze and thaw resistance*

EN 14617-6, *Agglomerated stone — Test methods — Part 6: Determination of thermal shock resistance*

EN 14617-9, *Agglomerated stone — Test methods — Part 9: Determination of impact resistance*

EN 14617-10, *Agglomerated stone — Test methods — Part 10: Determination of chemical resistance*

EN 14617-11, *Agglomerated stone — Test methods — Part 11: Determination of linear thermal expansion coefficient*

EN 14617-15, *Agglomerated stone — Test methods — Part 15: Determination of compressive strength*

EN 14618:2005, *Agglomerated stone — Terminology and classification*

EN 14889-1, *Fibres for concrete — Part 1: Steel fibres — Definitions, specifications and conformity*

EN 14889-2, *Fibres for concrete — Part 2: Polymer fibres — Definitions, specifications and conformity*

EN ISO 178, *Plastics — Determination of flexural properties (ISO 178:2001)*

EN ISO 584, *Plastics — Unsaturated polyester resins — Determination of reactivity at 80 °C (conventional method) (ISO 584:1982)*

EN ISO 2555, *Plastics — Resins in the liquid state or as emulsions or dispersions — Determination of apparent viscosity by the Brookfield Test method. (ISO 2555:1989)*

EN ISO 3219, *Plastics — Polymers/resins in the liquid state or as emulsions or dispersions — Determination of viscosity using a rotational viscometer with defined shear rate (ISO 3219:1993)*

EN ISO 9371, *Plastics — Phenolic resins in the liquid state or in solution — Determination of viscosity (ISO 9371:1990)*

EN ISO 10456, *Building materials and products — Hygrothermal properties —Tabulated design values and procedures for determining declared and design thermal values (ISO 10456:2007)*

3 Terms and definitions

For the purposes of this document the terms and definitions given in EN 14618:2005 and the following apply.

3.1
additive
material used to impart specific properties to the resin

3.2
binder
organic chemical product used to bind via an irreversible process the aggregates and the filler

3.3
characteristic value
value of a property below which 5 % of the population of all possible property determinations of the volume of resin-bound concrete under consideration are expected to fall

3.4
resin
liquid cross-linkable chemical product, generally constituted by a solution of a polymer in a monomer, used to form the organic binding paste

NOTE 1 Examples of most commonly used resins in polymer concrete are unsaturated polyester (i.e., polyester-styrene system), epoxy, and acrylic (i.e., methyl methacrylate monomer).

WARNING — The attention is drawn to the dangers which the handling of the resins and catalysts presents. Supplier's technical data sheet may give information on the precautions of use of such products.

3.5
resin-bound concrete
polymer concrete made with natural or artificial aggregates and an organic binder, which can be cast into forms or moulds by means of conventional concrete techniques (centrifugation or vibration/compaction process) or other techniques

4 Requirements

4.1 General

The specifications of the materials to be used shall be included in the production control documentation (see 6.3). If appropriate documents are available, they shall be used. If not available, the manufacturer shall specify the materials and have data on their suitability.

4.2 Constituent materials

4.2.1 Aggregates

4.2.1.1 General

General suitability is established for aggregates conforming to EN 12620.

Aggregates shall not contain harmful constituents in such quantities as may be detrimental to the curing, strength, and durability of the polymer concrete.

The size of particles in aggregates shall not exceed 1/3 of the smallest thickness of the product.

4.2.1.2 Grading

The aggregate grading shall be determined according to 5.1.1.1.

4.2.1.3 Water content

When required, the water content of the aggregates shall be determined according to 5.1.1.2.

4.2.2 Filler

General suitability is established for mineral fillers conforming to EN 12620.

Fillers shall not contain harmful constituents in such quantities as may be detrimental to the curing, strength, and durability of the resin bound concrete.

The filler grading shall be determined according to 5.1.2.

4.2.3 Resin

4.2.3.1 General

The resin shall be kept away from light, in a dry place and at a constant temperature.

4.2.3.2 Viscosity

Where the viscosity of the resin is to be determined, it shall be measured according to 5.1.3.1.

4.2.3.3 Reactivity

Where the reactivity of the resin is to be determined, it shall be measured according to 5.1.3.2.

4.3 Other materials

- Fibres

  Where fibres are used to strengthen the binder, general suitability is established for metallic fibres conforming to EN 14889-1 and for polymer fibres to EN 14889-2.

4.4 Properties of resin-bound concrete

4.4.1 General

The main properties of resin-bound concrete are defined below.

Product standards may identify additional properties.

Results obtained from testing shall be expressed as characteristic values.

4.4.2 Apparent density, water absorption and water permeability

When required, apparent density, water absorption and/or water permeability of resin-bound concrete shall be given and determined according to 5.3.

4.4.3 Strength

When required, flexural and/or compressive strength shall be given and determined according to 5.4.

4.4.4 Surface hardness

When required, the surface hardness shall be given and determined according to 5.5.

4.4.5 Slipperiness behaviour

When required, the unpolished or polished slip/skid resistance shall be given and determined according to 5.6.

4.4.6 Abrasion resistance

When required, the abrasion resistance shall be given and determined according to 5.7.

4.4.7 Thermal shock resistance

When required, the thermal shock resistance of resin-bound concrete shall be given and determined according to 5.8.

4.4.8 Impact resistance

When required, the impact resistance shall be given and determined according to 5.9.

4.4.9 Linear thermal expansion coefficient

When required, the linear thermal expansion coefficient shall be given and determined according to 5.10.

4.4.10 Chemical resistance

When required, the chemical resistance of resin-bound concrete shall be given and determined according to 5.11.

4.4.11 Freeze and thaw resistance

When required, the freeze and thaw resistance shall be given and determined according to 5.12.

4.4.12 Thermal conductivity

When required, thermal conductivity shall be given and determined according to 5.13.

4.4.13 Reaction to fire

When required, reaction to fire shall be given and determined according to 5.14.

5 Tests

5.1 Constituent materials

5.1.1 Aggregates

5.1.1.1 Grading

The aggregate grading shall be measured according to EN 933-1, and the results expressed accordingly.

5.1.1.2 Water content

The aggregate water content shall be measured according to EN 1097-5, and the results expressed accordingly.

5.1.2 Filler

The filler grading shall be measured according to EN 933-10, and the results expressed accordingly.

5.1.3 Resin

5.1.3.1 Viscosity

The viscosity of the resin shall be determined either by means of one of the following methods and the results expressed accordingly:

— Brookfield test method conforming to EN ISO 2555;

— test method described in EN ISO 3219;

— any test method conforming to EN ISO 9371 provided that its suitability is established for the kind of resin to be tested;

— test method described in Annex B.

5.1.3.2 Reactivity

The reactivity of the resin shall be determined either by means of one of the following methods and the results expressed accordingly:

— test method described in EN ISO 584;

— test method described in Annex B.

5.2 Test specimens

5.2.1 General

The properties of resin-bound concrete may be tested on specimens either cast from product mixes or cut from products.

Methods of preparing test specimens cut from products shall be as given in test standards or as specified in product standards.

5.2.2 Cast test specimens

Test specimens shall be produced from the product mix of the current production. The geometry, dimensions and number of cast specimens shall be at least equivalent to that for cut specimens from products as given in test standards. If required, cast specimens may subsequently be cut to size.

The mould used to cast specimens shall be made of a stiff, non-deformable material (like steel, cast iron, fibre reinforced plastic, etc.). A demoulding agent shall be used.

The mould shall be filled with fresh product mix. Care shall be taken to ensure consistency of filling (to avoid entrapped air) and compaction. Specimen shall be compacted through the application of pressure and/or vibration, manually and/or mechanically.

Test specimens shall be cured in same conditions of time and temperature as manufactured products.

At the end of the hardening period, the test specimen shall be demoulded, weighed, labelled with the production date and stored for a minimum period of time of 2 days without baking, as defined in the factory's production control system, at a temperature of 20 °C ± 2 °C and a relative humidity of 70 % ± 10 %. The dry storage period may be reduced if proof of a good correlation can be established between the characteristics measured for the reduced period compared to the characteristics after 2 days.

5.3 Apparent density, water absorption and water permeability

The apparent density, water absorption and water permeability of the resin-bound concrete shall be determined according to EN 14617-1 using test specimens prepared as described in 5.2.

5.4 Strength

The flexural strength shall be tested either by means of the method described in EN ISO 178 or in EN 14617-2, and the compressive strength in EN 14617-15, on test specimens prepared as described in 5.2.

5.5 Surface hardness

Surface hardness shall be tested according to the test method described in Annex C on test specimens prepared as described in 5.2.

5.6 Slipperiness behaviour

The unpolished or polished slip resistance shall be determined according to EN 14231 on test specimens prepared as described in 5.2.

5.7 Abrasion resistance

Abrasion resistance shall be determined according to EN 14617-4 on test specimens prepared as described in 5.2.

5.8 Thermal shock resistance

Thermal shock resistance shall be determined according to EN 14617-6 on test specimens prepared as described in 5.2.

5.9 Impact resistance

Impact resistance shall be determined according to EN 14617-9 on test specimens prepared as described in 5.2.

5.10 Linear thermal expansion coefficient

The linear thermal expansion coefficient of resin-bound concrete shall be determined according to EN 14617-11 on test specimens prepared as described in 5.2.

5.11 Chemical resistance

Chemical resistance shall be determined according to EN 14617-10 on test specimens prepared as described in 5.2.

5.12 Freeze and thaw resistance

Freeze and thaw resistance shall be determined according to 14617-5 on test specimens prepared as described in 5.2.

5.13 Thermal conductivity

Thermal conductivity shall be determined according to EN 12664 on test specimens prepared as described in 5.2. Design values of thermal conductivity shall be obtained by converting measured values according to EN ISO 10456.

5.14 Reaction to fire

Reaction to fire shall be tested according to EN 13823 and classified in accordance with EN 13501-1.

6 Evaluation of conformity

6.1 General

Evaluation of conformity requirements shall be given in product standards.

Compliance with the requirements of this document and with the declared values of properties shall be demonstrated by carrying out both:

— initial type testing of resin-bound concrete;

— factory production control.

6.2 Initial type tests

Initial type testing shall be carried out before a new type of material is put on the market.

When a new type of resin-bound concrete or a new production method is developed, initial type tests shall be carried out to confirm that the achieved properties meet the requirements of this document and the values to be declared for it. Whenever a major change occurs in raw materials, mix design or the production process, which would change the properties of the resin-bound concrete, the appropriate initial type tests shall be repeated.

NOTE A major change in raw materials means, for example, a change in the type of resin or of the catalytic system.

The type tests shall be the reference tests described in this document or in the relevant product standard.

Test methods shall be given in product standards.

The result of the initial tests shall be recorded.

6.3 Factory production control

6.3.1 General

A manufacturer operating a quality system in accordance with EN ISO 9001 and taking into account the requirements of this standard is deemed to satisfy the factory production control requirements as described hereafter.

6.3.2 Organisation

The tasks, responsibilities and authority of the personnel involved in factory production control shall be documented, maintained and implemented, including procedures for the following activities:

a) demonstration of conformity of the resin-bound concrete and of the resulting products at appropriate stages;

b) identification and recording of any instance of non-conformity;

c) handling of instances of non-conformity;

d) establishment of causes of non-conformity and possible corrective action (design, materials or production procedures).

An organisational scheme shall clarify the activities given in a) to d) of the personnel involved.

6.3.3 Control system

The manufacturer shall establish, document, maintain and implement a factory control system to ensure that the resin-bound concrete and the resulting products put on the market meet the requirements of this standard or in the relevant product standard and complies with the specified or declared values.

The factory production control system shall consist of procedures, instructions, regular inspections, tests and the utilisation of the results to control equipment, raw materials, other incoming materials, production process, resin-bound concrete and resulting products.

6.3.4 Document control

Documents shall be controlled in such a way that only valid copies are available in the workplace. These documents are the procedures, work instructions, standards, construction reports, drawings and the factory production control procedures.

The production drawings and documents shall provide the specifications and all data necessary for the manufacture (see 6.3.5) of the resin-bound concrete and the resulting products. They shall be dated and approved for production by a person designated by the manufacturer.

6.3.5 Process control

The manufacturer shall identify the relevant features of the plant and/or the production process. The manufacturer shall define the criteria and plan the production processes which directly affect the conformity of the resin-bound concrete and of the resulting products.

6.3.6 Inspection and testing

6.3.6.1 General

Inspection and testing shall be performed on equipment, raw materials, other incoming materials, production process, resin-bound concrete and resulting products. The subjects, criteria, methods and frequencies related to inspection and testing shall be laid down in inspection schemes. The frequency of checks and inspections and the methods which are not specified in this standard shall be defined in such a way as to achieve permanent conformity of the resin-bound concrete and the resulting products.

The inspection schemes given in the Tables 1 to 4 are reference schemes. The manufacturer shall apply the relevant parts of these schemes unless he can demonstrate that any changes which he makes to them achieve equal confidence in the conformity of resin-bound concrete and resulting products.

Switching rules for the rate of inspection subjects indicated in the inspection schemes are given in Table 5.

The results of inspection which are expressed in numerical terms, all inspection results requiring corrective action and test results, shall be recorded and be available.

The tests shall be carried out in accordance with the methods mentioned in the present standard or by applying alternative test methods with a proven correlation or a safe relationship to the standard methods.

The results of testing shall meet the specified compliance criteria and be available.

6.3.6.2 Equipment

The weighing, measuring and testing equipment used in the factory shall be calibrated and inspected following the reference schemes given in Table 1.

Inspection subjects do not apply if they are not relevant for the specific resin-bound concrete or if their purpose is fulfilled by other appropriate inspection.

Table 1 — Equipment inspection

	Subject	Method	Purpose	Frequency [a]
Testing and measuring equipment				
1	Strength testing equipment	Except as indicated in the test method, calibrating against equipment which has been calibrated to National specifications and is used exclusively for this purpose	Correct functioning and accuracy	— On (re) installation or after major repair — Once per year
2	Weighing equipment			
3	Dimension measuring equipment			
4	Temperature and humidity measuring equipment			
Storage and production equipment				
1	Storage of materials [b]	Visual inspection or other appropriate method	Absence of contamination	— On installation — Weekly
2	Weighing or volumetric batching equipment	Visual inspection	Correct functioning	— Daily
3		Calibrating against equipment which has been calibrated to National Standards and is used exclusively for this purpose	Manufacturer declared accuracy	— On (re)installation or after major repair — Weighing: once a year — Volumetric: twice a year — In case of doubt
4	Equipment for continuous measurement of water content of fine aggregates [c]	Comparison of the actual amount with the reading of the meter	Manufacturer declared accuracy	— On (re)installation — Twice a year — In case of doubt
5	Mixers	Visual inspection	Wear and correct functioning	— Weekly
6	Moulds	Visual inspection	Condition (e.g. wear and deformation)	— Regularly depending on the type of material and frequency of use
7	Casting machine / equipment	Manufacturer inspection instructions	Correct compaction of concrete	— Manufacturer inspection instructions

[a] National regulations prevail if they require higher frequency.

[b] For the resin, existence of a procedure for conservatory resin sampling mentioning the maximum admissible time and the storage conditions (i.e. protection against UV) shall be verified.

[c] Only if the equipment is available and the purpose is not covered by appropriate inspection(s) under Table 3 (resin-bound concrete) or Table 4 (product testing).

6.3.6.3 Materials

Raw materials and other incoming materials shall be inspected for compliance with the technical documentation according to 6.3.4.

The reference schemes for inspections, measurements and tests are given in Table 2.

Table 2 — Materials inspection

	Subject	Method	Purpose	Frequency [a]
All materials				
1	All materials	Inspection prior to discharge of delivery ticket and/or label on the package showing compliance with the order [b]	To ascertain that the consignment is as ordered and from the correct source	— Each delivery
Materials not submitted to an assessment of conformity before delivery [c]				
1	Resin [d]	Viscosity determination according to 5.1.3.1	Compliance with the data guaranteed in the supplier certificate	— Each delivery — In case of doubt, following visual inspection — Periodically during production of concrete
2		Reactivity determination according to 5.1.3.2	Conformity with suppliers stated data [a]	— Each delivery — In case of doubt, following visual inspection — Periodically during production of concrete
3	Additives [d]	Visual inspection	Conformity with normal appearance [a]	— Each delivery — Periodically during production of concrete
4	Aggregates	Visual inspection prior to discharge with respect to the grading shape and impurities	Conformity with suppliers stated data [a]	— Each delivery — When delivery is by belt conveyor and from the same source, periodically depending on local or delivery conditions
5		Testing according to 5.1.1.1	Compliance with agreed grading	— 1st delivery from new source — In case of doubt, following visual inspection — In case of doubt
6		Appropriate test method	Assessment of impurities or contamination	
7		Testing according to 5.1.1.2	Conformity with suppliers stated data (maximum 1 %)	
8	Filler [d]	Testing according to 5.1.2	Compliance with agreed grading [a]	
9	Fibres [d]	Visual inspection	Conformity with normal appearance	— Each delivery
10		Appropriate test method for metallic fibres according to EN 14889-1 and for polymer fibres to EN 14889-2	Conformity with suppliers stated data [a]	— In case of doubt

[a] The requirements of this standard may be completed by the manufacturers requirements.

[b] The order shall mention the specification(s).

[c] Materials not audited before delivery by the precast product manufacturer or by a third party acceptable to him.

[d] It is recommended that samples are taken at each delivery and stored for testing in case of doubt.

6.3.6.4 Production process

The schemes for inspections, measurements and tests are given in Table 3.

Table 3 — Process inspection

	Subject	Method	Purpose	Frequency [a]
Resin-bound concrete [a]				
1	Mixture composition (except binder content)	— Visual on weighing equipment — Checking against production documents	Conformity with intended composition (weight or volumetric batched)	— Daily for each composition used — After each change
2		Appropriate analysis	Conformity with intended mixture values (only volumetric batched)	— Weekly for each composition used
3	Binder content of fresh concrete	Appropriate method	Conformity with intended composition (weight or volumetric batched)	— Weekly for each composition used
4	Concrete mix	Visual check	Correct mixing	— Daily for each mixer
5	Mechanical strength [c]	Testing according to 5.4	To assess conformity with intended value [b]	— Weekly for each composition used
6	Apparent density of concrete [c]	Testing according to 5.3	To assess conformity with intended value [b]	
7	Surface hardness [c]	Testing according to 5.5	To assess conformity with intended value [b]	
Other process subjects [d]				
1	Moulds and beds	Visual inspection	Cleanliness and surface preparation with a demoulding agent [b]	— Daily
2			Check for wear and deformation	— Depending on moulding material and frequency of use
3		Measuring	Determination of dimensions	— Each new mould or after major modification
4	Before casting	Visual inspection	Conformity with production drawings	— Daily with frequency depending on moulding process
5	Concrete placing	Visual inspection	Correct compaction	— Daily
6	Curing	Visual inspection	Conformity with specification and documented factory procedures	— Daily
7		Verification of relevant conditions		— Weekly
8	Accelerated hardening	Verification of relevant conditions	Conformity with specification and documented factory procedures	— Daily
9		Measuring temperatures		— Depending on process
10	Post casting processing	As appropriate	Conformity with specifications and documented factory procedures	— Depending on process and specifications

[a] The indicated tests and frequencies may be adapted or even deleted when equivalent information is obtained directly or indirectly from the product.
[b] According to the manufacturers process requirements.
[c] Only if the property is specified.
[d] This inspection scheme may be adapted or completed for specific product purposes.

6.3.6.5 Finished products

A sampling and testing plan for the resin-bound concrete shall be prepared and implemented for all properties to be checked.

The reference inspection scheme is given in Table 4.

Table 4 — Finished product inspection

	Subject	Method	Purpose	Frequency [a]
Product Testing [a]				
1	Water absorption [b]	Testing according to 5.3	To assess conformity with intended value [b]	— Depending on product and property
2	Water permeability [b]	Testing according to 5.3		
3	Slipperiness behaviour [b]	Testing according to 5.6		
4	Abrasion resistance [b]	Testing according to 5.7		
5	Thermal shock resistance [b]	Testing according to 5.8		
6	Impact resistance [b]	Testing according to 5.9		
7	Linear thermal expansion coefficient [b]	Testing according to 5.10		
8	Chemical resistance [b]	Testing according to 5.11		
9	Freeze and thaw resistance [b]	Testing according to 5.12		
10	Thermal conductivity [b]	Testing according to 5.13		
11	Reaction to fire [b]	Testing according to 5.14		
12	Other properties [b]	Reference tests as described in the product standard (or correlated indirect testing)	Conformity with the requirements of the product standard and the requirements for the manufacturer declared properties	
13	Marking/Labelling	Visual check	Conformity with the requirements of the product standard and/or the requirements of the documented factory procedures	— Daily
14	Storage			
15	Delivery		Âge à la livraison, chargement et documents de chargement corrects	

[a] This inspection may be adapted and/or completed for specific product purposes.

[b] Only if the property is specified.

6.3.6.6 Switching rules

6.3.6.6.1 General

Switching rules only apply for inspection subjects (see Tables 1 to 4) related to the testing of sampled products, units or specimens providing quantified results checked against specified or declared values.

Switching rules apply for each selected subject separately.

Depending on the subject, a result considered for applying switching rules may be an individual result or may be related to a group of results obtained from a sample.

Table 5 — Switching rules

6.3.6.6.2 Normal inspection
The inspection rate shall be in accordance with Tables 1 to 4.
6.3.6.6.3 Normal to reduced inspection
Reduced inspection corresponds to half the rate of normal inspection. It may be used when normal inspection is effective and the 10 preceding successive results had been accepted.
6.3.6.6.4 Reduced to normal inspection
When reduced inspection is effective, normal inspection shall be reinstated if any of the following occurs: — a result is not accepted; or — production becomes irregular or delayed; or — other conditions warrant that normal inspection shall be instituted.
6.3.6.6.5 Normal to tightened inspection
Tightened inspection corresponds to double the rate of normal inspection. It shall be used when on normal inspection of five or less consecutive results, two have not been accepted.
6.3.6.6.6 Tightened to normal inspection
Tightened inspection continues until five consecutive results have been accepted. Then normal inspection may be resumed.
6.3.6.6.7 Stoppage of production
When inspection has to remain tightened for 10 consecutive results, production shall be stopped. The cause of the failure shall be investigated and any necessary remedial action shall be taken to restore product conformity. Production shall be resumed using tightened inspection.

6.3.7 Non-conforming products

If the results of factory production control reveal non-conformity of one or more properties of the resin-bound concrete with this standard or with the manufacturer's technical specifications, the manufacturer shall take the necessary steps in order to rectify the shortcoming.

If non-conformity indicates relevant effects on concrete properties, a report shall be produced. The report shall evaluate the possibility of acceptance after appropriate remedial measures or after downgrading the material for suitable uses within the scope of this standard. If no satisfactory remedial measure or downgrading is found, the faulty material shall be rejected.

Resin-bound concrete which does not comply with the requirements shall be set aside and marked accordingly.

Procedures dealing with non-conformity of the concrete concerning the properties stated in the standard or in the specification shall be documented.

6.3.8 Indirect or alternative test method

Any indirect or alternative test method may be used for testing concrete properties, provided a safe correlation is established and maintained with the direct method.

Annex A
(normative)

Determination of the viscosity of the resin

A.1 Aim

The control of the viscosity of the resin is a mean to guarantee the regularity of deliveries and to confirm that storage conditions are satisfactory.

A.2 Method

It is considered that the viscosity of a liquid is proportional to its flow time through a capillary tube. The principle of the test method is to measure the time taken by the resin to flow - under the action of gravity - in a capillary, between two marks defining a known volume. As viscosity varies very rapidly with temperature, the viscosimeter will be immersed for the duration of the manipulation into a thermostatically controlled bath.

A.3 Apparatus

The following equipement shall be used:

— UF type viscosimeter with a set of calibrated capillaries, consisting of:

  — UF viscosimetric tube (calibrated);

  — U-shaped container;

  — rubber bung;

  — support to fix the viscosimeter on the bath;

— thermostatically controlled bath set to (25 ± 0.2) °C;

— chronometer accurate to 0.1 s;

— beaker with pourer lip and a capacity of 150 ml;

— laboratory grade acetone;

— silicone grease;

— graduated pipette of 20 ml capacity with a bulb and a device to adjust the flow of the liquid (parts A and S).

NOTE Other types of viscosimeter are available on the market:

— Ubbelhode type (0.35 to 100,000 mm2/s);

— Ostwald type (0.63 to 4,000 mm2/s);

— Cannon-Fenske type (0.4 to 20,000 mm2/s).

The UF type viscosimeter is derived from the Ostwald type (Figure A.1). These viscosimeters are very easy to handle and they are normally supplied as calibrated.

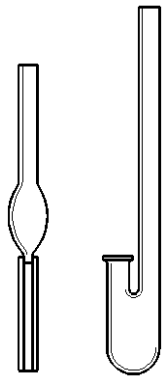

Figure A.1 — Example of viscosimeter

A.4 Procedure

A.4.1 Preliminary operations

Set the thermostatically controlled bath to (25 ± 0.2) °C.

Choose the capillary such that the flow speed of the resin is between 3 min and 6 min inclusive.

NOTE 1 This is to avoid causes of error due to a flow that is too fast or not fast enough.

Clean the apparatus thoroughly with acetone, and dry it with air.

NOTE 2 Any impurity may have a serious effect on the results.

A.4.2 Test procedure

The resin sampling is not the responsibility of the test laboratory except when specially requested. The sampling shall be obtained from the same batch.

Pour the resin to be tested into the beaker and, using its pourer lip, introduce into the U-tube a quantity of resin equivalent to 2/3 of the volume of the tank.

Grease the base of the capillary tube with silicone grease.

Fit the tube into the bung and fit the assembly on the tank so that the end of the capillary is immersed in the resin.

Install the apparatus on the thermostatically controlled bath by means of the mounting so that the tank is totally immersed.

Wait for approximately 10 min to allow the temperatures to stabilize.

Install the pipette on the capillary tube and squeeze it by pressing on the part A while pressing the bulb.

Bring (by pressing on the part S of the pipette) the level of the resin to approximately 1 cm above the top mark.

Once the level is reached, press on the part A of the pipette to decompress it.

Take the apparatus out of the bath in order to raise the capillary tube (its lower part must no longer be immersed in the resin).

Place the apparatus in the bath, making sure the tank is totally immersed.

Remove the pipette from the capillary tube. The resin will then flow.

When the level of the resin reaches the first mark (upper point), start the chronometer.

When the level of the resin reaches the second mark (lower point), stop the chronometer.

Note the time, t, in seconds.

Carry out a second test which must give a time, t, identical to the nearest second to the first.

A.5 Results

Calculate the viscosity of the resin using the following equation:

$$\eta = k \cdot \rho \cdot T \quad (1)$$

where

η viscosity of the resin in poises;

k constant due to calibration by gravity (mentioned in the instructions delivered with the apparatus);

ρ density of the resin at 25 °C (given by the supplier);

t time of flow of the resin in seconds.

Annex B
(normative)

Determination of the reactivity of the resin

B.1 Aim

The control of the reactivity of the resin is a mean to guarantee the regularity of deliveries and to confirm that storage conditions are satisfactory.

B.2 Method

This test method describes the operating procedure in order to measure the following properties of a resin at a given temperature of use, T, corresponding to industrial conditions of production:

— gelling time;

— exothermic peak time;

— exothermic peak temperature.

B.3 Apparatus

— Glass beaker with a capacity of 250 ml and an internal diameter of 60 mm;

— thermometer with sensor and an accuracy of 1 °C;

— graduated pipette of 1 ml capacity + pipette bulb;

— chronometer accurate to 0.1 s;

— thermostatically controlled bath set to a temperature $T \pm 0.2$ °C;

— balance reading in grams and accurate to 0.1 % of the reading.

B.4 Procedure

The resin sampling is not the responsibility of the test laboratory except when specially requested. The sampling shall be obtained from the same batch.

Weigh 100 g of the resin into the beaker.

Place the beaker in the thermostatically controlled bath set to the temperature T. The beaker is immersed to a depth 3 times that of the height of the resin.

NOTE Example of temperature T at which the thermostatically controlled bath can be regulated: 28 ± 0.2 °C.

Agitate the resin using the thermometer sensor until the temperature T (+0.3; 0.0) °C is reached.

Add 2 ml of the catalyst. Start the chronometer once the catalyst has been added.

Continue to mix with the sensor for 1 min.

Note the gelling time corresponding to the end of the liquid phase and the beginning of the solid phase, and place the sensor in the centre of the gelled resin; the bottom of the sensor head must touch the base of the container.

Note the peak temperature and the exothermic peak time.

B.5 Results

Record the gelling time in seconds to the nearest 15 s, the peak time to the nearest 20 s, and the peak temperature to the nearest 10 °C.

NOTE Examples of results for a resin are given below:

— Gelling time: 2 min 50 s ± 15 s;

— Peak time: 7 min 35 s ± 20 s;

— Peak temperature: 85 °C ± 10 °C.

Annex C
(normative)

Determination of the surface hardness

C.1 Aim

By measuring the surface hardness of the product before and after curing at a given temperature, this test method enables any insufficiency of polymerization to be detected.

NOTE This test along with the water absorption test must be considered as a whole.

C.2 Method

The hardness of the binder is measured with a penetrometer, e.g. a Barcol Impressor, at different points of the surface of a product before and after passing through an oven at 80 °C.

The hardness tester indicates directly in arbitrary units (e.g. degrees Barcol), the force exercised by the penetrometer on the weighted spring to embed the point in the product.

NOTE The Barcol Impressor is an apparatus similar to the Shore hardness analyser.

C.3 Apparatus

— Ventilated oven set to 80 °C ± 5 °C;

— hardness tester (e.g. Barcol Impressor);

NOTE A Barcol impressor conforming to ASTM E140-97A standard, or a durometer of the 934 type conforming to NF T 57-106 standard are well suited

— set of calibration tablets.

C.4 Procedure

C.4.1 Calibration of the hardness tester

Place the calibration tablet on a plane surface, hold the hardness tester firmly with both hands and apply the penetrometer to the tablet perpendicular to its surface.

Press down rapidly and read the maximum value reached by the needle immediately. The reading must be within the bracket shown on the tablet. If any difference is noted, change the setting of the lower guide screen until a reading within the bracket is obtained.

C.4.2 Test procedure

The sampling is not the responsibility of the test laboratory except when specially requested. At least 3 specimens shall be selected from an homogeneous batch. Store the test specimens beforehand for 24 h in an atmosphere at (20 ± 2) °C and (50 ± 5) % relative humidity.

NOTE Alternatively, store the test specimens at ambient temperature in the laboratory and note this in the factory production control.

Mark 10 separate zones over the entire surface of each test specimen.

Carry out 10 hardness measurements (series 1) on each test specimen, while taking the same precautions as for calibration. Note each result. For each test specimen, calculate the arithmetic means H_1.

Place the test specimens in the oven at (80 ± 5) °C for (24 ± 1) h, and then place them in the initial atmosphere for 4 days.

Repeat the series of 10 measurements on each test specimen, taking care not to place the point in a hole left by the previous measurement (before baking). Note each result. For each test specimen, calculate the arithmetic means H_2.

C.5 Results

For each test specimen, determine the increase in hardness, H, in %.

$$H\ \% = \frac{H_2 - H_1}{H_1} \times 100$$

NOTE 1 An increase in hardness ≥ 15 % is indicative of incomplete polymerisation of the binder.

NOTE 2 For resin-bound concrete, an increase in hardness of less than 5 %, on a direct reading, corresponds to an ideal degree of polymerisation.

NOTE 3 The results can be greatly influenced by the degree of wear of the penetrometer. It is therefore important to ensure that it is always in good condition. The apparatus is specially designed for use with materials of uniform consistency.

NOTE 4 Polymerisation which is incomplete may exceptionally remain unchanged during baking, a phenomenon known as "polymerisation blocking". Tests based on the curing process by heating (hardness and dimensional variations) will therefore be inapplicable but, under these conditions, an absorption test is useful for detecting inadequate polymerisation.

NOTE 5 Readings can be taken after stabilisation of the penetration of the needle of the penetrometer. In this case, it is necessary to maintain the pressure on the apparatus for a maximum of 10 s. With this method of reading, the hardness values after baking are approximately identical to those obtained by direct reading (mean difference of 1 degree Barcol). However, the increase in hardness as a percentage is approximately 6.5 % greater than the value determined by direct reading, owing to differences before curing by heating.

Bibliography

[1] Recent Progress in Concrete-Polymer Composites, Yoshihiko Ohama, Advanced cement-based materials, Elsevier, 1997 [5], pp 31-40.

[2] EN ISO 9001, *Quality management systems - Requirements (ISO 9001:2000)*

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@bsigroup.com You may also buy directly using a debit/credit card from the BSI Shop on the Website http://www.bsigroup.com/shop

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 Information Centre. Tel: +44 (0)20 8996 7111 Fax: +44 (0)20 8996 7048 Email: info@bsigroup.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@bsigroup.com

Information regarding online access to British Standards via British Standards Online can be found at http://www.bsigroup.com/BSOL

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

Copyright

BSI Group
Headquarters 389
Chiswick High Road,
London, W4 4AL, UK
Tel +44 (0)20 8996 9001
Fax +44 (0)20 8996 7001
www.bsigroup.com/
standards