BRITISH STANDARD

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Precast concrete products — General rules for factory production control of glass-fibre reinforced cement

The European Standard EN 1169:1999 has the status of a British Standard

ICS 91.100.30

National foreword

This British Standard is the English language version of EN 1169:1999.

The UK participation in its preparation was entrusted to Technical Committee B/524, Precast concrete products, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

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

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Summary of pages

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Precast concrete products — General rules for factory production control of glass-fibre reinforced cement

Produits préfabriqués en béton — Règles générales de contrôle de production des composites ciment-verre

Vorgefertigte Betonerzeugnisse — Allgemeine Regeln für die werkseigene Produktionskontrolle von Glasfaserbeton

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CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

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Foreword

This European Standard 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of an identical text or by endorsement, at the latest by April 2000, and conflicting national standards shall be withdrawn at the latest by April 2000.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Contents

1 Scope

This European Standard is applicable to glass-fibre reinforced cement products manufactured in factories. It defines the general rules for production control of GRC material.

It constitutes the common "production" part of the control plan, for which guidelines are given in annex A.

It does not specify:

— the conformity control procedure for the finished products, for which reference should be made to the specification of European products standards or, if none exist, to the technical requirements defined and agreed between the manufacturer and his customer;

— the means and methods to be used to control the whole production process (moulds, curing, storage, etc.).

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

prEN 197-1, *Cement — Part 1: Composition, specifications and conformity criteria for common cements.*

EN 450, *Fly ash for concrete — Definitions, requirements and quality control.*

EN 1170-1, *Precast concrete products — Test method for glass-fibre reinforced cement — Part 1: Measuring the consistency of the matrix "Slump test" method.*

EN 1170-2, *Precast concrete products — Test method for glass-fibre reinforced cement — Part 2: Measuring the fibre content in fresh GRC, "Wash out test".*

EN 1170-3, *Precast concrete products — Test method for glass-fibre reinforced cement — Part 3: Measuring the fibre content of sprayed GRC.*

EN 1170-4, *Precast concrete products — Test method for glass-fibre reinforced cement — Part 4: Measuring bending strength — "Simplified bending test" method.*

EN 1170-5, *Precast concrete products — Test method for glass-fibre reinforced cement — Part 5: Measuring bending strength, "Complete bending test" method.*

EN 1170-6, *Precast concrete products — Test method for glass-fibre reinforced cement — Part 6: Determination of the absorption of water by immersion and determination of the dry density.*

EN 1170-7, *Precast concrete products — Test method for glass-fibre reinforced cement — Part 7: Measurement of extremes of dimensional variations due to moisture content.*

ENV 1170-8, *Test method for glass-fibre reinforced cement — Part 8: Cyclic weathering type test.*

EN 45001, *General criteria for the operation of testing laboratories.*

3 Definitions and abbreviation

3.1 Definitions

For the purposes of this standard, the following definitions apply.

3.1.1

additive

product that may be added to the matrix composition to improve some properties. It can be reactive (e.g. silica fumes) or inert, mineral or organic (e.g. polymer dispersions)

3.1.2

admixture

product added in quantity less than 5% of the mass of cement, before or during mixing and giving expected modifications to the initial properties (e.g. plasticizer, air entraining agents)

3.1.3

AR glass-fibre (alkali-resistant)

glass-fibre resistant to the alkaline environment of matrices made from hydraulic binder. This resistance is due particularly to a specific composition of glass

3.1.4

E glass-fibre (electrical)

glass-fibre usually used in the composites with organic binder. Due to the composition of glass, this type of fibre is degraded in alkaline environment

3.1.5

basic strand

glass fibre obtained by stranding 100 to 200 filaments having 10 μm to 30 μm individual diameter

3.1.6

glass-fibre reinforced cement

composite material consisting of a matrix of hydraulic binder (cement) reinforced with glass-fibres, these materials being compatible

3.1.7

matrix

part of glass-fibre reinforced cement comprising the mixture of sand, cement, water and if necessary additives and admixtures

3.1.8

spray process

process whereby continuous glass-fibre is cut into set lengths and sprayed together with the matrix. The process is designed to give a glass-fibre reinforced cement in which the fibres are oriented parallel to the mould surface

3.1.9

premix process

process whereby chopped strands of glass-fibres are blended with the matrix to make a glass-fibre reinforced cement ready for processing. The process may be: "casting and vibration", wet or dry spraying, injection, extrusion, etc.

3.1.10

Quality Assurance Manual (QAM)

document describing the general measures taken by a manufacturer in the field of quality assurance. This document is the non-confidential contractual part of the Quality Manual, if this exists

3.1.11

Quality Assurance Plan (QAP)

document describing the general measures taken by a manufacturer to conform with the requirements relating to a given production. QAM and QAP may be blended

3.1.12

control plan

document describing the specific measures used to effect the control of a product

3.2 Abbreviation

GRC: glass-fibre reinforced cement

4 Control of raw materials

4.1 General

The raw materials shall conform to the requirements of the European Standards or if none exist to national standards valid in the place of use. In particular Portland cements shall comply with prEN 197-1 and fly ashes with EN 450.

If no standard exists, raw materials shall be covered in technical specifications describing the nature of the requirements for GRC and agreed by the supplier and the manufacturer.

The use of E glass-fibres is not recommended with Portland cement, unless in a modified cement matrix of which its performance and their change with time have been identified in accordance with ENV 1170-8.

NOTE 1 To estimate the resistance of glass-fibres to alkalis of Portland cement, it is recommended to refer to the GRCA publications no. S 0104/0184 and no. S 0105/0286. They define a test "Strand In Cement — S.I.C. Test" and give requirements for glass-fibres to be used in matrices with hydraulic binder.

NOTE 2 The glass-fibres are used in the following forms: chopped strands, continuous rovings/fibres (stratifils), nets, and mats.

4.2 Reception controls

Each delivery batch shall be identified by the supplier and be accompanied by a delivery document which specifies particularly:

— for sands: the grain size analysis within the specified limits, the cleanness, the water content and the chemical analysis;

— for polymers: the family of polymers, the dry extract and the limit of use date;

— for cements: the type of cement and the strength class;

— for glass-fibres: the quality of the glass (e.g. AR), the diameter of filaments, definition of the strand and loss on ignition.

It is recommended that the GRC producer takes a sample for retention from each delivery batch in accordance with Table 1.

NOTE If the case arises, the reception controls (all or a part) could be carried out by the producer.

Table 1 — Retention samples to be taken from each delivery batch

Materials		Approximate mass kg	Duration of retention months
Glass-fibres		0,5	6
Cement		5	1
Sands		5	1
Additions	Polymers	1	6
	Metakaolin, silica fumes and other fillers	1	6
Admixtures		0,5	6
Water		—	—

4.3 Storage of raw materials

All raw materials shall be stored in a sheltered place, in such a way they do not mix with others and are protected against deterioration or contamination. For certain materials, as indicated in the supplier's written instructions, protection from frost is necessary to preserve the qualities of the products.

The rotation of stocks shall be ensured so that oldest stock is always used first.

5 Control of the mixing process

The equipment shall be used in such a way that in common circumstances the following tolerances can be obtained:

— for additives, cement, water and aggregates: ±2 % of the required quantity;

— for admixtures: ±3 % of the required quantity.

The verification of conformity shall be carried out as follows:

— once a year by a body accredited for calibration in accordance with EN 45001;

— at regular intervals by the GRC producer.

The frequency, depending on the risk of deviation in the accuracy of equipment, shall be defined in the quality assurance plan.

6 Controls of hardened and fresh GRC

Tables 2, 3 and 4 summarize the control tests with indicative frequencies which shall be adjusted according to the product type to be processed.

The manufacturer shall ensure that the frequencies adopted ensure control of the production process and control of the properties of the finished product. These frequencies should not be less than stated in Tables 2, 3, and 4.

Table 2 — Summary of control tests on fresh GRC: premix process

Test	Indicative frequency	Requirement	Corrective action if test result is outside the limit values
Consistency of matrix in accordance with EN 1170-1	Initially to set up a matrix formula, then at least once a day per mixer	Optimal value determined according to the production cycle. Value of the acceptable variation range generally accepted: 1 circle, i.e. 20 mm	Modify the formula (e.g. rectify water content)
Fibre content of fresh GRC in accordance with EN 1170-2	Once a week for each set of weighing equipment	Deviation ≤1 %	Adjust the process

Table 3 — Summary of control tests on fresh GRC: spray process

Test	Indicative frequency	Requirement	Corrective action if test result is outside the limit values
Consistency of matrix in accordance with EN 1170-1	Initially to set up a matrix formula, then at least once a day per mixer	Optimal value determined according to the production cycle. Value of the acceptable variation range generally accepted: 1 circle, i.e. 20 mm	Modify the formula (e.g. rectify water content)
Direction verification of rates in accordance with EN 1170-3	For each pump: at least once a day and after each incident in the production that could question the conformity of the rate of fibres. The frequency is reduced to two controls per week when the fibre content is regularly (period longer than one month) in the acceptable range without change the adjustment of the air pressure	Optimal value determined according to the production cycle. Value of the acceptable variation range generally accepted: ±0,2 %	Adjust the process
Fibre content of fresh GRC in accordance with EN 1170-2	Once a week per spray operator	Deviation ≤1,5 %	Adjust the process

Table 4 — Summary of control tests on hardened GRC

Test	Indicative frequency	Requirement	Corrective action if test result is outside the limit values
Bending strength by the "complete bending test" method in accordance with EN 1170-5, carried out by the manufacturer or by a qualified laboratory	Initially to set up a GRC formula and at least twice a year. At each change in the formula	Required value determined according to the end-use of the product	See annex A (informative) of EN 1170-4:1997
Bending strength by the "simplified bending test" method, carried out by the manufacturer in accordance with EN 1170-4	Each 10 t of GRC and at least once a week		
Water absorption by immersion and dry density in accordance with EN 1170-6[1)]	Initially to set up a formula, then each 10 t of GRC and at least once a week		— modify the formula (e.g. reduce water/cement ratio) — improve compaction
Extreme dimensional variations according to the water content, carried out by the manufacturer or by a qualified laboratory, in accordance with EN 1170-7[1)]	Initially to set up a new GRC formula. No frequency is indicated, except in the case of change of parameters (GRC formula, curing, short delivery time)		
Cyclic weathering type test carried out by a qualified laboratory, in accordance with ENV 1170-8[2)]		—	—

[1)] These two tests are complementary and the importance of the results depends on the use of the product.
[2)] Climatic cycle test (cycle weathering type test) allows identification for a particular GRC formula (raw materials and their content in the formula) the impact of the environmental effects such as water and temperature on the change with time of mechanical characteristics.
The existing national standards may be maintained in use in parallel with ENV 1170-8 up to the final decision to convert the pre-standard into a standard. This decision will be based mainly on the on the conclusions of the European test campaign carried out in 1994-1995 on the initiative of CEN/TC 229.

Annex A (normative)

Guidelines for establishment of the quality assurance

Factory production control consists of a permanent organization and provisions to ensure that a product subsequently placed on the market conforms with the technical requirements defined at the order: product standard or if this does not exist technical specifications agreed between the manufacturer and his customer.

The production control plan shall be drawn up in a document including the following items:

a) *Design*

— The manufacturer shall describe how design requirements and criteria are identified, checked, controlled and updated to be unambiguous and relevant to the use of the product and its specification.

— The manufacturer shall describe the procedures for communication of the design requirements to the production departments or possible external sub-contractors.

b) *Production*

— Raw materials: the manufacturer shall define the acceptance criteria of the raw materials he uses and the procedures he employs to ensure that these are met.

— Production process: the relevant features of the production process shall be defined giving the frequency of the inspections, checks and tests, together with the values or criteria required. The action to be taken when control values or criteria are not obtained shall be specified. Weighing and measuring equipment shall be calibrated.

c) *Finished products*

— Tests on the finished products: when the production control system includes tests on samples of the finished products, the size of the samples and the frequency of sampling, together with the results obtained, shall be recorded to demonstrate the control of products conforming to the declared properties.

— Alternative tests: where alternative tests to reference tests are used, the alternative test procedure and its correlation with the reference test shall be recorded.

— Equipment: test equipment shall be calibrated.

— Assessment of results: where possible and applicable, the results of inspections, checks and tests shall be interpreted statistically to determine whether the corresponding production conforms to the complete criteria and the declared values for the products.

d) *Records*

The dates, together with details and results of inspections, checks and tests shall be recorded. Results of finished product shall be kept at least for 10 years.

e) *Traceability*

The systems of traceability and control of designs, raw materials, production process, and storage of the finished products shall be defined.

f) *Corrective actions for non-conforming raw materials and products*

It is essential that the immediate actions to be taken in case of non-conformity with specified requirements should be described and recorded. These actions shall include the steps necessary to: rectify the deficiency and complete if necessary the manual in order to prevent another incident, isolate the defective raw materials and finished products, and determine whether they shall be discarded or re-specified.

g) *Personnel*

The manufacturer shall ensure that the personnel involved in the control process are suitably trained. The job description and responsibility of the operatives shall be defined.

h) *Management*

The management system implemented to ensure that all the above requirements operate shall be described.

Manufacturers operating a Quality System conforming to EN ISO 9001 or EN ISO 9002 are deemed to meet the requirements in this annex.

Annex B (informative)

Bibliography

EN ISO 9001, *Quality systems — Model for quality assurance in design, development, production, installation and servicing.*

EN ISO 9002, *Quality systems — Model for quality assurance in production and installation.*

GRCA S 0104/0184, *Method of test for strength retention of glass-fibre in cements and mortars — January 1984.*

GRCA S 0105/0286, *Specification for alkali resistant glass-fibre rovings and chopped strands for reinforcement of cements and concretes — February 1986.*

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