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Assessment and Verification of the Constancy of Performance (AVCP) of aggregates - Type testing and Factory Production Control

National foreword

This British Standard is the UK implementation of EN 16236:2018. It supersedes BS EN 16236:2013, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee B/502/6, Test methods.

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

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English Version

Assessment and Verification of the Constancy of Performance (AVCP) of aggregates - Type testing and Factory Production Control

Evaluation et Vérification de la Constance des Performances (EVCP) des granulats - Essais de types et Maîtrise de la production en usine

Bewertung der Konformität von Gesteinskörnungen - Erstprüfung und werkseigene Produktionskontrolle

This European Standard was approved by CEN on 24 April 2017.

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European foreword

This document (EN 16236:2018) has been prepared by Technical Committee CEN/TC 154 “Aggregates”, the secretariat of which is held by BSI.

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of an identical text or by endorsement, at the latest by January 2019, and conflicting national standards shall be withdrawn at the latest by April 2020.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN not be held responsible for identifying any or all such patent rights.

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association.

This European Standard is intended for use with future revisions (currently in preparation) of the standards listed below. It is not for use with the versions of these standards dated 2002 (plus amendment A1).

EN 12620, *Aggregates for concrete;*

EN 13043, *Aggregates for bituminous mixtures and surface treatments for roads, airfields and other trafficked areas;*

EN 13139, *Aggregates for mortar;*

EN 13242, *Aggregates for unbound and hydraulic bound materials for use in civil engineering work and road construction;*

EN 13383-1, *Armourstone — Part 1: Specification;*

EN 13450, *Aggregates for railway ballast.*

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

Introduction

This European Standard has been written as the system for the Assessment and Verification of the Constancy of Performance (AVCP) of aggregates.

This European Standard is intended for use with future revisions (currently in preparation) of the standards listed below. It is not for use with the versions of these standards dated 2002 (plus amendment A1).

It is intended to be used in conjunction with the future aggregate product standards: EN 12620, EN 13043, EN 13139, EN 13242, EN 13383-1 and EN 13450 and will be called up by these standards. This European Standard and the corresponding product standards have been written under the Construction Products Regulation (CPR).

According to Annex ZA of these standards, the tasks relative to AVCP for the manufacturer comprise Type Testing (TT) and Factory Production Control (FPC).

This standard has been compiled from the TT and FPC clauses, annexes and tables previously found in the aggregate product standards. A further revision of this standard is currently under preparation, which will provide more detailed TT procedures and clear, detailed procedures for product conformity (e.g. statistical conformity criteria, number of samples, tolerances, time limits of validity, etc).

The type testing and factory production control procedures are designed to be applied to European Standards for aggregates. When the appropriate “conformity” clauses are applied, it forms part of the system of assessment and verification of constancy of performance as required by the Construction Products Regulation. It provides the minimum provisions for TT and FPC for CE Marking.

The testing procedures, using the reference test methods, have the function of providing assurance that a particular aggregate product conforms to each of the selected specified characteristics in the product standard. The type testing procedure is designed to be applied to all harmonized elements of European Harmonized Standards for aggregates.

The factory production control system describes control of the sourcing and processing of the aggregate combined with routine sampling and testing to provide ongoing assurance that the aggregates product continues to conform to those characteristics determined through TT. Testing within FPC may use either the standard reference tests called up by the aggregate product standards or other test procedures which have been shown to correlate with those tests.

For commercial and/or contractual reasons, the manufacturer can choose to perform more testing and inspection than the minimum specified.

1 Scope

This European Standard specifies both type testing and factory production control procedures for use during the assessment and verification of constancy of performance of aggregates.

Additional testing carried out within contracts is beyond the scope of this standard.

This European Standard is applicable to European Standards for aggregates if regulatory marking of conformity is to be applied. It is also applicable to European Standards for aggregates where regulatory marking does not apply.

This European Standard is applicable to the type testing and factory production control of aggregates within the scope of EN 12620, EN 13043, EN 13242, EN 13139, EN 13383-1 and EN 13450.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 196-2, *Method of testing cement — Part 2: Chemical analysis of cement*

EN 196-6, *Methods of testing cement — Part 6: Determination of fineness*

EN 459-2, *Building lime — Part 2: Test methods*

EN 932-1, *Tests for general properties of aggregates — Part 1: Methods for sampling*

EN 932-3, *Tests for general properties of aggregates — Part 3: Procedure and terminology for simplified petrographic description*

EN 932-5, *Tests for general properties of aggregates — Part 5: Common equipment and calibration*

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

EN 933-3, *Tests for geometrical properties of aggregates — Part 3: Determination of particle shape — Flakiness index*

EN 933-4, *Tests for geometrical properties of aggregates — Part 4: Determination of particle shape — Shape index*

EN 933-5, *Tests for geometrical properties of aggregates — Part 5: Determination of percentage of crushed and broken surfaces in coarse aggregate particles*

EN 933-6, *Tests for geometrical properties of aggregates — Part 6: Assessment of surface characteristics — Flow coefficient of aggregates*

EN 933-7, *Tests for geometrical properties of aggregates — Part 7: Determination of shell content — Percentage of shells in coarse aggregates*

EN 933-8, *Tests for geometrical properties of aggregates — Part 8: Assessment of fines — Sand equivalent test*

EN 933-9, *Tests for geometrical properties of aggregates — Part 9: Assessment of fines — Methylene blue test*

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

EN 933-11, *Tests for geometrical properties of aggregates — Part 11: Classification test for the constituents of coarse recycled aggregate*

EN 1097-1, *Tests for mechanical and physical properties of aggregates — Part 1: Determination of the resistance to wear (micro-Deval)*

EN 1097-2, *Tests for mechanical and physical properties of aggregates — Part 2: Methods for the determination of resistance to fragmentation*

EN 1097-3:1998, *Tests for mechanical and physical properties of aggregates — Part 3: Determination of loose bulk density and voids*

EN 1097-4, *Tests for mechanical and physical properties of aggregates — Part 4: Determination of the voids of dry compacted filler*

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

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

EN 1097-7, *Tests for mechanical and physical properties of aggregates — Part 7: Determination of the particle density of filler — Pyknometer method*

EN 1097-8:2009, *Tests for mechanical and physical properties of aggregates — Part 8: Determination of the polished stone value*

EN 1097-9, *Tests for mechanical and physical properties of aggregates — Part 9: Determination of the resistance to wear by abrasion from studded tyres — Nordic test*

EN 1097-10, *Tests for mechanical and physical properties of aggregates — Part 10: Determination of water suction height*

EN 1367-1, *Tests for thermal and weathering properties of aggregates — Part 1: Determination of resistance to freezing and thawing*

EN 1367-2, *Tests for thermal and weathering properties of aggregates — Part 2: Magnesium sulfate test*

EN 1367-3, *Tests for thermal and weathering properties of aggregates — Part 3 : Boiling test for "Sonnenbrand basalt"*

EN 1367-4, *Tests for thermal and weathering properties of aggregates — Part 4: Determination of drying shrinkage*

EN 1367-5, *Tests for thermal and weathering properties of aggregates — Part 5: Determination of resistance to thermal shock*

EN 1367-6, *Tests for thermal and weathering properties of aggregates — Part 6: Determination of resistance to freezing and thawing in the presence of salt (NaCl)*

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

EN 1744-4, *Tests for chemical properties of aggregates — Part 4: Determination of water susceptibility of fillers for bituminous mixtures*

EN 1744-5, *Tests for chemical properties of aggregates — Part 5: Determination of acid soluble chloride salts*

EN 1744-6, *Tests for chemical properties of aggregates — Part 6: Determination of the influence of recycled aggregate extract on the initial setting time of cement*

EN 1926:2006, *Natural stone test methods — Determination of uniaxial compressive strength*

EN 12620, *Aggregates for concrete*

EN 12697-11, *Bituminous mixtures — Test methods for hot mix asphalt — Part 11: Determination of the affinity between aggregate and bitumen*

EN 13043, *Aggregates for bituminous mixtures and surface treatments for roads, airfields and other trafficked areas*

EN 13139, *Aggregates for mortar*

EN 13179-1, *Tests for filler aggregate used in bituminous mixtures — Part 1: Delta ring and ball test*

EN 13179-2, *Tests for filler aggregate used in bituminous mixtures — Part 2: Bitumen number*

EN 13242, *Aggregates for unbound and hydraulically bound materials for use in civil engineering work and road construction*

EN 13383-1, *Armourstone — Part 1: Specification*

EN 13383-2, *Armourstone — Part 2: Test methods*

EN 13450, *Aggregates for railway ballast*

3 Terms and definitions

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

3.1
type testing
complete set of tests or other procedures, determining the performance of samples of aggregates representative of the product type

3.2
Declaration of Performance
DoP
expression of the performance of an aggregate in relation to its essential characteristics in accordance with the relevant harmonised standards

3.3
category
level or class of a characteristic of an aggregate expressed as a range of values (class) or a threshold value (level for individual value or declared category)

Note 1 to entry: There is no relationship between the categories of different characteristics.

Note 2 to entry: 'level' is defined in the CPR as "the result of the assessment of the performance of an aggregate in relation to its essential characteristics, expressed as a numerical value". Reference should be made to the latest version of the CPR.

Note 3 to entry: 'class' is defined in the CPR as "a range of levels, delimited by a minimum and a maximum value, of performance of an aggregate". Reference should be made to the latest version of the CPR.

Note 4 to entry: 'Threshold level' is defined in the CPR as "a minimum or maximum performance level of an essential characteristic of an aggregate product.

3.4
declared value
value or range of values that a manufacturer is confident in achieving, taking into account the precision of test methods used, the variety of the production processes and the product performance

3.5
week of production
5 cumulative days of production in a period no longer than 3 months

Note 1 to entry: In the Tables 1 to 3 of the present standard, "week" means week of production.

3.6
month of production
20 cumulative days of production in a period no longer than 6 months

3.7
year of production
at least one day of production in a period no longer than 12 months

Note 1 to entry: In the Tables 1 to 3 of the present standard, "year" means year of production.

Note 2 to entry: For the purpose of the test frequencies, a year of production is the same as a calendar year.

3.8
batch
production quantity, delivery quantity, partial delivery quantity (railway wagon, load, lorry load, ship's cargo) or stockpile produced at one time under conditions that are presumed uniform

Note 1 to entry: With a continuous process the quantity produced during a specified period should be treated as a batch.

4 Assessment and Verification of Constancy of Performance - AVCP

4.1 General

The conformity of aggregates within the scope of EN 12620, EN 13043, EN 13242, EN 13139, EN 13383-1 and EN 13450 with the specifications of this standard and with the performances declared by the manufacturer in the DoP shall be demonstrated by:

— determination of the product type;

— factory production control by the manufacturer, including product assessment.

The manufacturer shall always retain overall control and shall have the necessary means to take responsibility for the conformity of the product with its declared performance.

NOTE The assignment of tasks to the notified body and the manufacturer is shown in Annex ZA, Table ZA.3.1 of FprEN 12620:2017 FprEN 13043:2017 FprEN 13242:2017 FprEN 13139:2017 FprEN 13383–1:2017 and FprEN 13450:2017

4.2 Type testing

4.2.1 General

The performance of each characteristic included in this standard shall be determined when the manufacturer intends to declare the respective performance unless the standard gives provisions for declaring them without performing tests, e.g. use of previously existing data, classified without (further) testing and conventionally accepted performance.

Assessment previously performed in accordance with the provisions of this standard, may be taken into account provided that they were made to the same or a more rigorous test method, under the same AVCP system on the same product or products of similar design, construction and functionality, such that the results are applicable to the product in question.

For the purposes of assessment, the manufacturer's products may be grouped, where it is considered that the results for one or more characteristics from any one product are representative for that same characteristics for all grouped products.

Products may be grouped in different ways for different characteristics.

In addition, the determination of the product type shall be performed for all characteristics included in the standard for which the manufacturer declares the performance when:

a) a new source of aggregates is to be used (for recycled aggregates, the processing depot will suffice for the source);

b) there is a major change in the nature of the raw materials or in the processing conditions that may affect the characteristics of the aggregates.

Where aggregates are used whose characteristics have already been determined, by the aggregate manufacturer, on the basis of assessment methods of other product standards, these characteristics need not be re-assessed. The specifications of these aggregates shall be documented.

4.2.2 Test samples, testing and conformity criteria

The number of samples of aggregates to be tested shall be determined by the manufacturer. The conformity criteria are given in Tables 1, 2 and 3.

4.2.3 Test reports

The results of the determination of the product type shall be documented in test reports. All test reports shall be retained by the manufacturer for at least 10 years after the construction product has been placed on the market.

NOTE Please note the possible existence of local legislation regarding the length of time that such records are kept. "Statutory period" is the period of time during which all the records are kept in accordance with regulations applying at the place of production.

4.2.4 Shared other party results

A manufacturer may use the results of the product type determination obtained by someone else (e.g. by another manufacturer or as a common service to manufacturers), to justify his own declaration of performance regarding aggregates that are manufactured with the same grading and with raw materials, constituents and manufacturing methods of the same kind, provided that:

— the results are known to be valid for aggregates with the same essential characteristics relevant for the aggregate performance;

— in addition to any information essential for confirming that aggregates have such same performances related to specific essential characteristics, the other party who has carried out the determination of the product type concerned or has had it carried out, has expressly accepted to transmit to the manufacturer the results and the test report to be used for the latter's product type determination, as well as information regarding production facilities and the production control process that can be taken into account for FPC;

— the manufacturer using other party results accepts to remain responsible for aggregates having the declared performances and he also:

- ensures that aggregates have the same characteristics relevant for performance as the one that has been subjected to the determination of the product type, and that there are no significant differences with regard to production facilities and the production control process compared to that used for aggregates that were subjected to the determination of the product type; and

- keeps available a copy of the determination of the product type report that also contains the information needed for verifying that aggregates are manufactured according to the same design and with raw materials and manufacturing methods of the same kind.

4.3 Factory Production Control (FPC)

4.3.1 General

The manufacturer shall establish, document and maintain a FPC system to ensure that the aggregates placed on the market conform to the declared performance of the essential characteristics.

The FPC system shall consist of procedures, regular inspections and tests and/or assessments and the use of the results to control raw materials, equipment, the production process and the product.

All the elements, specifications and provisions adopted by the manufacturer shall be documented in a systematic manner in the form of written policies and procedures.

The manufacturer shall establish and maintain a factory production control manual setting out the procedures by which the factory production control is fulfilled.

This factory production control system documentation shall ensure a common understanding of the evaluation of the constancy of performance and shall enable the achievement of the product performances and the effective operation of the production control system to be checked. Factory production control therefore brings together operational techniques and all measures allowing maintenance and control of the conformity of the aggregates with the declared performances of the essential characteristics.

NOTE The form of control applied to any aggregate depends upon its intended use and the regulations relating to that use.

In case the manufacturer has used shared product type results, the FPC shall also include the appropriate documentation as foreseen in 4.2.1.

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

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

4.3.2 Procedure

4.3.2.1 General

The manufacturer is responsible for organizing the effective implementation of the FPC system in line with the content of the relevant product standard. Tasks and responsibilities in the production control organization shall be documented and this documentation shall be kept up-to-date.

The responsibility, authority and the relationship between personnel that manage, perform or verify work affecting product constancy, shall be defined. This applies in particular to personnel that need to initiate actions preventing product non-constancies from occurring, actions in case of non-constancies and to identify and register product constancy problems.

NOTE 1 Constancy of performance is shown when the conformity criteria of Table 1, 2 or 3 are fulfilled

Personnel performing work affecting the constancy of performance of the product shall be competent on the basis of appropriate education, training or skills and experience for which records shall be maintained.

The manufacturer may delegate the action to a management representative having the necessary authority to:

— identify procedures to demonstrate constancy of performance of the aggregates at appropriate stages;

— identify and record any instance of non-constancy;

— identify procedures to correct instances of non-constancy.

This management representative may be responsible for several production facilities.

The manufacturer shall draw up and keep up-to-date documents defining the factory production control. The manufacturer's documentation and procedures should be appropriate to the product and manufacturing process. The FPC system should achieve an appropriate level of confidence in the constancy of performance of the product. This involves:

a) the preparation of documented procedures and instructions relating to factory production control operations, in accordance with the provisions addressed in the product standard to which reference is made;

b) the effective implementation of these procedures and instructions;

c) the recording of these operations and their results;

d) the use of these results to correct any deviations, repair the effects of such deviations, treat any resulting instances of non-conformity and, if necessary, revise the FPC to rectify the cause of non-constancy of performance.

Some characteristics may be shared by several products (see 4.2.1), in which case the manufacturer, based on his experience, may find it possible to apply the results of one test to more than one product.

NOTE 2 This can be the case when a product is the combination of two or more different aggregate sizes of the same origin of production.

Where the product inspected or tested does not conform to the declared value or declared category, a note shall be made in the records of the steps taken to deal with the situation.

NOTE 3 Such a note could report carrying out of a new test and/or putting measures in place to correct the production process.

All documentation within the scope of this standard shall be retained by the manufacturer for at least 10 years after the construction product has been placed on the market.

NOTE 4 Please note the possible existence of local legislation regarding the length of time that such records are kept. “Statutory period” is the period of time for which all the records are kept in accordance with regulations applying at the place of production.

Where subcontracting takes place, the manufacturer shall retain the overall control of the product and ensure that he receives all the information that is necessary to fulfil his responsibilities according to this European standard.

NOTE 5 Subcontract services involve the work carried out by a third party on behalf of the manufacturer.

If the manufacturer has part of the product manufactured, packed, processed and/or labelled by subcontracting, the FPC of the subcontractor may be taken into account, where appropriate for the product in question.

The manufacturer who subcontracts activities may in no circumstances pass the above responsibilities on to a subcontractor.

NOTE 6 Manufacturers having an FPC system which complies with EN ISO 9001 standard and which addresses the provisions of the present European standard are considered as satisfying the FPC requirements of the Regulation (EU) No 305/2011.

All the necessary facilities, equipment and trained personnel to perform the inspections and tests shall be made available.

4.3.2.2 Management review

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

4.3.2.3 Equipment

4.3.2.3.1 Testing

The manufacturer shall be responsible for the control, calibration and maintenance of inspection, measuring and test equipment according to documented procedures, frequencies and criteria.

Accuracy and frequency of calibration shall be in accordance with EN 932-5.

Equipment shall be used in accordance with documented procedures.

Equipment shall be uniquely identified.

Calibration records shall be retained (see 4.3.2.1).

4.3.2.3.2 Manufacturing

Equipment used in the manufacturing process should be regularly inspected and maintained to ensure use, wear or failure does not cause inconsistency in the manufacturing process. Where appropriate, inspections and maintenance can be carried out and recorded in accordance with the manufacturer's written procedures and the records retained for the period defined in the manufacturer's FPC procedures.

4.3.2.4 Raw materials

There shall be documentation detailing the nature of the raw material, its source and, where appropriate, one or more maps showing the location and extraction plan. Maps are not appropriate for manufactured or recycled aggregates, for natural aggregate raw materials arising from less closely defined locations, such as marine aggregates, or for manufacturers using aggregates already put on the market.

The specifications of all incoming materials (raw material or product) shall be documented, as shall the inspection scheme for ensuring their conformity.

The manufacturer shall ensure that if any dangerous substances are identified, they fulfil the provisions valid in place of use of the product.

In addition, for recycled aggregates, there shall be a documented input control of raw material to be recycled.

The input control procedures for recycling shall identify:

— nature of the raw material;

— place of origin of production;

— supplier and transporting agent.

For recycled aggregates, the processing depot will suffice for the origin of production.

4.3.2.5 Traceability and marking

The product shall be identifiable and traceable with regard to its production origin. The manufacturer shall have written procedures ensuring that processes related to affixing traceability codes and/or markings are inspected regularly.

4.3.2.6 Controls during manufacturing process

The manufacturer shall plan and carry out production under controlled conditions.

4.3.2.7 Product testing and evaluation

The manufacturer shall establish procedures to ensure that the stated values of the characteristics declared are maintained. The characteristics, test methods, conformity criteria and minimum frequency of testing are specified in Tables 1, 2 and 3.

Testing within FPC may use either the standard reference tests called up by the aggregate product standards or other test procedures which have been shown to correlate with those tests.

4.3.2.8 Non-conforming products

The manufacturer shall have written procedures which specify how non-conforming products shall be dealt with. Any such events shall be recorded and these records shall be kept for the period defined in the manufacturer's written procedures.

Where the product fails to satisfy the conformity criteria, the provisions for non-conforming products shall apply

The non-conforming product shall be:

a) reprocessed; or

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

c) reclassified into a less stringent category, or

d) rejected and marked as non-conforming.

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

The product description, date of manufacture, test method adopted, test results and conformity criteria shall be entered in the records.

Once the non-conformity has been corrected, the test or verification in question shall be repeated.

4.3.2.9 Corrective actions

The manufacturer shall have documented procedures that investigate action to eliminate the cause of non-conformities in order to prevent recurrence.

Corrective actions can include:

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

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

3) initiating preventive actions to deal with problems to a level corresponding to the risks encountered;

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

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

4.3.2.10 Handling, storage and packaging

The manufacturer shall have procedures for aggregates handling and shall make the necessary arrangements to maintain the quality of the product during handling and storage.

Where appropriate, these arrangements should take account of the following:

a) contamination;

b) segregation;

c) cleanliness of handling equipment and stocking areas.

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

4.3.2.11 Transport

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

NOTE When aggregates are transported in bulk, it can be necessary to cover or contain aggregates to reduce contamination and the loss of matter due to the potential creation of air borne dust.

4.3.3 Product specific FPC

The FPC system shall satisfy the specifications of this European Standard and ensure that the products placed on the market conform to the declaration of performance.

The FPC system shall include a product specific FPC, which identifies procedures to demonstrate conformity of the product at appropriate stages, i.e. the verifications and tests to be carried out on finished products according to a frequency laid down in the FPC test plan.

The manufacturer shall prepare a schedule of test frequencies taking into account the minimum provisions of Tables 1 to 3.

All samples used in factory production control shall be representative of the material in question and shall be taken in accordance with EN 932-1 or in the case of armourstone EN 13383-2.

NOTE 1 Test frequencies are generally related to periods of production (see Table 1 to 3). A period of production is defined as a week, month or year of production (see 3.5 to 3.7).

The factory production control may introduce visual inspection. Any deviations indicated by these inspections may lead to additional testing.

NOTE 2 Tables 1, 2 and 3 specify the minimum test frequencies. It belongs to the manufacturer to increase the frequency of testing, for example when the measured value is close to a specified category limit / threshold.

Under special conditions, and when properly documented, the test frequencies may be decreased below those given in Tables 1 to 3. These conditions could be:

— highly automated production equipment;

— long-term experience with consistency of special characteristics;

— sources of high conformity;

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

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

In order to provide evidence that the production has been sampled and tested, the manufacturer shall establish and maintain records that include sampling locations, dates and times and products tested. These records shall show clearly whether the production has satisfied the defined conformity criteria.

4.3.4 Initial inspection of production unit and of FPC

NOTE For the application of this task under AVCP system 2+, see the Annex ZA of the relevant harmonized standard.

Initial inspection of production unit and of FPC system shall be carried out when the production process has been finalized and in operation. The production unit and FPC documentation shall be assessed to verify that the sub-clauses 4.3.2 and 4.3.3 are fulfilled.

During the inspection it shall be verified:

a) that all resources necessary for the achievement of the product characteristics included in this European standard are in place and correctly implemented;

and

b) that the FPC-procedures in accordance with the FPC documentation are followed in practice;

and

c) that the product complies with the product type sample criteria, against which conformity of the product performance to the DoP has been verified.

All locations, where final testing of the relevant product is performed, shall be assessed to verify that the above conditions a) to c) are in place and implemented. If the FPC system covers more than one product and it is verified that the general specifications are fulfilled when assessing one product then the assessment of the general specifications does not need to be repeated when assessing the FPC for another product.

All assessments and their results shall be documented in the initial inspection report.

4.3.5 Continuous surveillance of FPC

NOTE 1 For the application of this task under AVCP system 2+, see the Annex ZA of the relevant harmonized standard.

Surveillance of the FPC shall be undertaken at least once per year.

For multiple site production under the same FPC system, surveillance of individual production sites may be undertaken once every three years.

NOTE 2 See GNB/CPR SG02 position paper.

The surveillance of the FPC shall include a review of the FPC test plan(s) and production processes(s) for each product to determine if any changes have been made since the last assessment or surveillance.

The significance of any changes shall be assessed.

Checks shall be made to ensure that the test plans are still correctly implemented and that the production equipment is still correctly maintained and calibrated at appropriate time intervals.

The records of tests and measurement on the finished products shall be reviewed to ensure that the values obtained still correspond with those values for the samples submitted to the determination of the product type and that the correct actions have been taken for non-conforming products.

4.3.6 Procedure for modifications

If modifications are made to product, production process or FPC system that could affect any of the aggregates characteristics declared according to the relevant aggregate standard, then all the characteristics for which the manufacturer declares performance, which may be affected by the modification, shall be subject to the determination of the product type, as described in 4.2.1.

Where relevant, a re-assessment of the factory and of the FPC system shall be performed for those aspects, which may be affected by the modification.

All assessments and their results shall be documented in a report.

5 Minimum test frequencies and conformity criteria

Minimum test frequencies and conformity criteria are given in Tables 1 to 3.

NOTE Frequencies indicated by “week”, “month”, and “year” in the following tables mean a “week of production”, “month of production”, and “year of production”.

Table 1 — Conformity criteria for the characteristics specified in EN 12620, EN 13043, EN 13139, EN 13242 and minimum test frequencies for the factory production control

Characteristic & Test method		Conformity criteria	EN 12620		EN 13043		EN 13139		EN 13242	
			Notes	Minimum test frequency	Notes	Minimum test frequency	Notes	Minimum test frequency	Notes	Minimum test frequency
Geometrical characteristics										
1	Grading EN 933–1 EN 933–10	At least 90 % of the test results are within the values declared by the manufacturer (taken on different samples within a maximum production period of 6 months)	-	1 per week	-	1 per week	-	1 per week	-	1 per week
2	Fines content EN 933–1	At least 90 % of the test results are within the values declared by the manufacturer (taken on different samples within a maximum production period of 6 months)	-	1 per week	-	1 per week	-	1 per week	-	1 per week
3	Fines quality EN 933–8 EN 933–9	At least 90 % of the test results are within the values declared by the manufacturer (taken on different samples within a maximum production period of 6 months)	Only when the fines content of fine aggregate or all-in aggregate exceeds the value specified	1 per week	Only when the fines content of fine aggregates or $0/D$ all-in aggregate with $D \leq 8$ mm exceeds the value specified	2 per year	Only when the fines content of fine aggregate or all-in aggregate exceeds the value specified	1 per week	Only when the fines content of fine aggregate or all-in aggregate exceeds the value specified	1 per week

Characteristic & Test method		Conformity criteria	EN 12620		EN 13043		EN 13139		EN 13242	
			Notes	**Minimum test frequency**	**Notes**	**Minimum test frequency**	**Notes**	**Minimum test frequency**	**Notes**	**Minimum test frequency**
4	Shape of coarse and all-in aggregate EN 933–3 EN 933–4	According to the relevant category	Test frequency applies to crushed or broken aggregate. Test frequency for rounded gravel depends on the source and may be reduced	1 per month	Test frequency applies to crushed or broken aggregate. Test frequency for rounded gravel depends on the source and may be reduced	1 per month	-	-	Test frequency applies to crushed or broken aggregate. Test frequency for rounded gravel depends on the source and may be reduced	1 per month
5	Shell content EN 933–7	According to the relevant category	Coarse and all-in aggregates of marine origin only	1 per year	-	-	Coarse and all-in aggregates of marine origin only	1 per year	-	-
6	Percentage of crushed particles EN 933–5	According to the relevant category	-	-	For gravel only	1 per month	-	-	For gravel only	1 per month
7	Angularity of fine and all-in aggregates EN 933–6	According to the relevant category	-	-	-	1 per month	-	-	-	1 per month
8	Harmful fines EN 933–9	According to the relevant category	-	-	For filler only	2 per year	-	-	-	-

Characteristic & Test method		Conformity criteria	EN 12620		EN 13043		EN 13139		EN 13242	
			Notes	Minimum test frequency	Notes	Minimum test frequency	Notes	Minimum test frequency	Notes	Minimum test frequency
Physical characteristics										
9	Resistance to fragmentation EN 1097–2	According to the relevant category	For high strength concrete only	2 per year	-	1 per year	-	-	-	2 per year
10	Resistance to wear EN 1097–1	According to the relevant category	For surface courses only	1 per year	-	1 per year	-	-	-	2 per year
11	Particle density EN 1097–6	Declared value	-	1 per year	-	1 per 2 years	-	1 per year	-	1 per year
12	Water absorption EN 1097–6	Declared value	-	1 per year	-	-	-	1 per year	-	1 per year
13	Particle density of filler aggregate EN 1097–7	Declared value	-	-	-	1 per year	-	-	-	-
14	Bulk density EN 1097–3	Declared value	-	-	-	For filler, see line 22	-	-	-	1 per year
15	Water suction height EN 1097–10	According to the relevant category	-	-	-	-	-	-	-	1 per year
16	Resistance to polishing for surface courses (PSV) EN 1097–8	According to the relevant category	For surface courses only	1 per year	For surface courses only	1 per year	-	-	-	-

Characteristic & Test method		Conformity criteria	EN 12620		EN 13043		EN 13139		EN 13242	
			Notes	Minimum test frequency	Notes	Minimum test frequency	Notes	Minimum test frequency	Notes	Minimum test frequency
17	Resistance to surface abrasion (AAV) EN 1097–8:2009, Annex A	According to the relevant category	For surface courses only	1 per year	For surface courses only	1 per year	-	-	-	-
18	Resistance to abrasion from studded tyres to be used for surface areas EN 1097–9	According to the relevant category	For surface courses only in regions where studded tyres are used	1 per year	For surface courses only in regions where studded tyres are used	1 per year	-	-	-	-
19	Affinity to bituminous binders EN 12697–11	According to the relevant category	-	-	-	1 per year	-	-	-	-
20	Water content EN 1097–5	According to the relevant category	-	-	For filler only	2 per week	-	-	-	-
21	Stiffening properties EN 1097–4 EN 13179–1	According to the relevant category	-	-	Voids of dry compacted filler (Rigden) EN 1097–4	2 per year	-	-	-	-
					Delta ring and ball EN 13179–1	2 per year				

Characteristic & Test method		Conformity criteria	EN 12620		EN 13043		EN 13139		EN 13242	
			Notes	**Minimum test frequency**	**Notes**	**Minimum test frequency**	**Notes**	**Minimum test frequency**	**Notes**	**Minimum test frequency**
22	Consistency of filler production EN 1097–7 EN 13179–2 EN 1744–1 EN 1097–3:1998, Annex B EN 196–6	According to the relevant category	-	-	For filler only	1 per week	-	-	-	-
Chemical characteristics										
23	Petrographic description EN 932–3	Declared petrographic type	-	1 per 3 years	-	1 per 3 years	-	1 per 3 years	-	1 per 3 years
24	Dicalcium silicate disintegration of air-cooled blast furnace slag EN 1744–1	Declared value	-	2 per year	-	2 per year	-	-	-	2 per year
25	Iron disintegration of air-cooled blast furnace slag EN 1744–1	Declared value	-	2 per year	-	2 per year	-	-	-	2 per year
26	Volume stability of steel slag EN 1744–1	According to the relevant category	-	-	-	2 per year	-	-	-	2 per year

Characteristic & Test method		Conformity criteria	EN 12620		EN 13043		EN 13139		EN 13242	
			Notes	**Minimum test frequency**	**Notes**	**Minimum test frequency**	**Notes**	**Minimum test frequency**	**Notes**	**Minimum test frequency**
27	Drying shrinkage EN 1367–4	According to the relevant category	-	1 per 5 years	-	-	-	-	-	-
28	Chloride content: EN 1744–1	Declared value	For non marine aggregate	1 per 2 years	-	-	For non marine aggregate	1 per 2 years	-	-
			For marine aggregate	1 per week			For marine aggregate	1 per week		
29	Sulfur containing compounds EN 1744–1	According to the relevant category	For air cooled blast furnace slag only	2 per year	-	-	-	-	-	-
			Aggregates others than air cooled blast furnace slag	1 per year				1 per year and in case of doubt		1 per year

Characteristic & Test method		Conformity criteria	EN 12620		EN 13043		EN 13139		EN 13242	
			Notes	**Minimum test frequency**	**Notes**	**Minimum test frequency**	**Notes**	**Minimum test frequency**	**Notes**	**Minimum test frequency**
	Constituents which alter the rate of setting and hardening:									
30	— humus content / sodium hydroxide test EN 1744–1	Declared value	-	1 per year	-	-	In case of doubt	1 per week	-	1 per year
	— fulvo acid test EN 1744–1	Declared value	When a high humus content is indicated	1 per year	-	-	In case of doubt	1 per week	-	1 per year
	— comparative strength test – stiffening time EN 1744–1	According to the relevant category	For fillers and fine aggregates if humus and fulvo acid tests fail, and if presence of sugar or sugar type materials is suspected	1 per year	-	-	When required	1 per week	When sodium hydroxide test fails	1 per year
	— lightweight contaminators EN 1744–1	Declared value	-	2 per year	-	-	-	When required for a particular end use	-	-
		According to the relevant category	-	-	Aggregate $D > 2$ mm in case of doubt	1 per year	-	-	-	-
31	Carbonate content EN 196–2	According to the relevant category	Only for fine aggregate for concrete surfaces	1 per 2 years	For filler only	1 per year	-	-	-	-

Characteristic & Test method		Conformity criteria	EN 12620		EN 13043		EN 13139		EN 13242	
			Notes	**Minimum test frequency**	**Notes**	**Minimum test frequency**	**Notes**	**Minimum test frequency**	**Notes**	**Minimum test frequency**
32	Calcium carbonate content EN 1744–1 EN 196–2	According to the relevant category	-	-	For limestone filler only	1 per year	-	-	-	-
33	Calcium hydroxide content EN 459–2	According to the relevant category	-	-	For mixed filler only	1 per year	-	-	-	-
34	Water solubility EN 1744–1	According to the relevant category	-	-	For filler only	1 per 2 years	Only for manufactured aggregates	1 per week	-	-
35	Water susceptibility EN 1744–4	According to the relevant category	-	-	For filler only	1 per 2 years	-	-	-	-
36	Loss on ignition EN 1744–1,	According to the relevant category	-	-	For coal fly ash used as filler aggregates only	See line 21	For pulverized fly ash and air cooled blast furnace slag only	1 per week	-	-

Characteristic & Test method		Conformity criteria	EN 12620		EN 13043		EN 13139		EN 13242	
			Notes	**Minimum test frequency**	**Notes**	**Minimum test frequency**	**Notes**	**Minimum test frequency**	**Notes**	**Minimum test frequency**
Durability characteristics										
37	Dangerous substances, in particular: — emission of radioactivity — release of heavy metals — release of polyaromatic hydrocarbons	See provisions valid in the place of use								
38	Resistance to weathering EN 1367–2	According to the relevant category	-	1 per 2 years	-	1 per 2 years	-	1 per 2 years and in case of doubt	-	1 per 2 years
39	Water absorption as a screening test for freeze–thaw resistance EN 1097–6	According to the relevant category	-	1 per 2 years	-	1 per 2 years	-	1 per 2 years	-	1 per 2 years
40	Resistance to freezing and thawing EN 1367–1	According to the relevant category	-	1 per 2 years	-	1 per 2 years	-	1 per 2 years	-	1 per 2 years

Characteristic & Test method		Conformity criteria	EN 12620		EN 13043		EN 13139		EN 13242	
			Notes	**Minimum test frequency**	**Notes**	**Minimum test frequency**	**Notes**	**Minimum test frequency**	**Notes**	**Minimum test frequency**
41	Resistance to freezing and thawing in the presence of salt (extreme conditions) EN 1367–6	According to the relevant category	-	1 per 2 years	-	1 per 2 years	-	1 per 2 years and in case of doubt	-	1 per 2 years
42	“Sonnenbrand” of basalt EN 1367–3	According to the relevant category	-	-	In case of doubt where signs of “Sonnenbrand” are known	2 per year	-	-	In case of doubt where signs of “Sonnen-brand” are known	2 per year
43	Resistance to thermal shock EN 1367–5	According to the relevant category	-	-	-	1 per year	-		-	
44	Alkali-silica reactivity	See Notes	-	See provisions valid in the place of use	-	-	-	See provisions valid in the place of use	-	

Table 2 — Conformity criteria for the characteristics of recycled aggregates specified in EN 12620, EN 13139, EN 13242 and supplementary minimum test frequencies for FPC

Characteristic & Test method			Conformity criteria	Minimum test frequencies	
				Level 1 [a]	Level 2 [a]
1	EN 1097–6	Particle density and water absorption for EN 12620 and EN 13242	According to the relevant category	1 per week	1 per month
2	EN 1744–5	Acid soluble chloride content for EN 12620 and EN 13139	According to the relevant category	2 per month	2 per year
3	EN 1744–6	Influence on initial setting time of cement for EN 12620	According to the relevant category	4 per year	2 per year
4	EN 933–11	Constituents of coarse recycled aggregates for EN 12620 and EN 13242	According to the relevant category	2 per month	1 per month
5	EN 1744–1	Water soluble sulfate for EN 12620 and EN 13242	According to the relevant category	1 per week	1 per month
6	EN 1744–1	Sulfur containing compounds for EN 12620	According to the relevant category	2 per year	2 per year

[a] Selected level of the minimum test frequency is dependent on the particular application or end use.

Table 3 — Conformity criteria for the characteristics specified in EN 13383-1 and EN 13450 and minimum test frequencies for FPC

Characteristic & Test method		Conformity criteria	EN 13383–1		EN 13450	
			Notes	Minimum test frequency	Notes	Minimum test frequency
Geometrical characteristics						
1	Particle size distribution EN 13383–2	According to the relevant category	Coarse gradings only	1 per 20 000 t and immediately after a production break of at least 6 months	-	-
2	Mass distribution EN 13383–2	According to the relevant category	Light mass gradings and heavy mass gradings only	1 per 20 000 t and immediately after a production break of at least 6 months	-	-
3	Grading EN 933–1	At least 90 % within the values declared by the manufacturer (taken on different samples within a maximum production period of 6 months)	-	-	-	1 per week
4	Content of fine particles EN 933–1	At least 90 % within the values declared by the manufacturer (taken on different samples within a maximum production period of 6 months)	-	-	-	1 per week

Characteristic & Test method			Conformity criteria	EN 13383–1		EN 13450	
				Notes	**Minimum test frequency**	**Notes**	**Minimum test frequency**
5	Fines content EN 933–1		At least 90 % within the values declared by the manufacturer (taken on different samples within a maximum production period of 6 months)	-	-	-	1 per week
6	Shape	Armourstones: EN 13383–2	According to the relevant category	Length to thickness ratio	1 per 20 000 t and immediately after a production break of at least 6 months	-	1 per month
		Ballasts: EN 933–3 and EN 933–4					
7	Particle length EN 13450		According to the relevant category	-	-	-	1 per month
8	Proportion of crushed or broken surfaces EN 13383–2		According to the relevant category	Only for armourstone used in structures, in which rounded pieces could lead to instability	1 per 20 000 t	-	-
9	Percentage of crushed particles EN 933–5		According to the relevant category	-	-	Not necessary for aggregates obtained from crushed massive rock as they are considered to be C 100/0 and thus do not require further testing.	1 per month

Characteristic & Test method			Conformity criteria	EN 13383–1		EN 13450	
				Notes	Minimum test frequency	Notes	Minimum test frequency
Physical characteristics							
10	Resistance to breakage EN 1926:2006, Annex A		According to the relevant category	Compressive strength test	1 per 5 years	-	-
11	Resistance to fragmentation EN 1097–2		According to the relevant category	-	-	-	2 per year
12	Resistance to wear EN 1097–1		According to the relevant category	Only for armourstone for a top layer, which is known to be subject to abrasion by sediment	1 per 2 years	-	2 per year
13	Particle density	EN 13383–2	Declared value	-	1 per year	-	-
		EN 1097–6	Declared value	-	-	-	2 per year
14	Water absorption EN 1097–6		Declared value	-	-	-	2 per year
Chemical characteristics							
15	Petrographic description EN 932–3		Declared petrographic type	-	1 per 5 years	-	1 per 3 years
16	Dicalcium silicate disintegration EN 1744–1		According to the relevant category	For air-cooled blast furnace slag only	2 per year	-	-

Characteristic & Test method		Conformity criteria	EN 13383–1		EN 13450	
			Notes	**Minimum test frequency**	**Notes**	**Minimum test frequency**
17	Iron disintegration EN 1744–1	According to the relevant category	For air-cooled blast furnace slag only	2 per year	-	-
18	Desintegration of steel slag EN 13383–2	According to the relevant category	Disintegration of steel slag	2 per year	-	-
19	Impurities EN 13383–2	According to the relevant category	Visual	Each batch	-	-
20	Dangerous substances, in particular: — emission of radioactivity — release of heavy metals — release of polyaromatic hydrocarbons	See provisions valid in the place of use				
Durability characteristics						
21	Water absorption as a screening test for resistance to freezing and thawing and to salt crystallization EN 13383–2	According to the relevant category	-	1 per 2 years	-	-

Characteristic & Test method			Conformity criteria	EN 13383–1		EN 13450	
				Notes	Minimum test frequency	Notes	Minimum test frequency
22	Resistance to freezing and thawing	EN 13383–2	According to the relevant category	-	1 per 2 years	-	-
		EN 1367–1 and EN 13450	According to the relevant category	-	-	-	2 per year
23	Resistance to salt crystallization EN 1367–2		According to the relevant category	-	1 per 2 years	-	2 per year
24	"Sonnen-brand" of basalt	EN 13383–2	According to the relevant category	In case of doubt where signs of "Sonnenbrand" are known	2 per year	-	-
		EN 1367–3 and EN 1097–2	According to the relevant category	-	-	-	2 per year
25	Electrical conductivity		See provisions valid in the place of use	-	-	See provisions valid in the place of use	

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