BS EN 13450:2013

BSI Standards Publication

Aggregates for railway ballast

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National foreword

This British Standard is the UK implementation of EN 13450:2013. It supersedes BS EN 13450:2002 which is withdrawn.

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

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

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

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Aggregates for railway ballast

Granulats pour ballasts de voies ferrées

Gesteinskörnungen für Gleisschotter

This European Standard was approved by CEN on 22 December 2012.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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Foreword

This document (EN 13450:2013) 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of an identical text or by endorsement, at the latest by November 2013, and conflicting national standards shall be withdrawn at the latest by February 2015.

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.

This document supersedes EN 13450:2002.

The main changes compared to the previous edition are:

1) Updating of the normative references (deletion of the reference to EN 932-5, updating of the references to EN 1367-1:2007 and EN 1367-2:2009 and addition of the references to EN 1367-6 and EN 16236-2013).

2) Modification of the definition to "recycled railway ballast".

3) Addition of note 3 in Clause 4.

4) Modification of Tables 1, 2, 3, 4, 5, 6, 7, 8 and 9 due to changes in the category names.

5) Addition of new sub-clauses 7.3 "Freeze-thaw resistance" and 7.4 "Electrical conductivity".

6) Modification of sub-clause 7.5 "Sonnenbrand".

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this document.

Requirements for other end uses of aggregates will be specified in the following European Standards:

— EN 12620, *Aggregates for concrete*;

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

— EN 13055, *Lightweight aggregates*;

— EN 13139, *Aggregates for mortar*;

— 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*.

Considering evaluation of conformity see EN 16236, Evaluation of Conformity.

According to the CEN/CENELEC Internal Regulations, the national standards organisations 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, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

1 Scope

This European Standard specifies the properties of aggregates obtained by processing natural, manufactured or recycled crushed unbound aggregates for use in construction of the upper layer of railway track. For the purposes of this standard, the aggregate is referred to as railway ballast.

A list of the source materials that have been considered and are within the scope of this European Standard is given in Annex E (normative).

NOTE Reused railway ballast: railway ballast resulting of previously used railway ballast on site and without putting it on the market is not covered by this European Standard.

It also specifies that a quality control system is in place for use in factory production control and it provides for the evaluation of conformity of the products to this European Standard.

It incorporates a general requirement that railway ballast should not release any dangerous substances in excess of the maximum permitted levels specified in a relevant European Standard for the material or permitted in the national regulations of the member state of destination.

Railway ballast used in construction should comply with all the requirements of this European Standard. The standard includes comprehensive and specific requirements for natural aggregates and recycled ballast, dealing with, for example, the stability of certain basalts.

For materials from some other secondary sources, however, work is ongoing and the requirements are incomplete. In the meantime such materials, when placed on the market as railway ballast, should conform fully to this standard but may also be required to conform to specific relevant additional requirements at the place of use. Additional characteristics and requirements may be specified on a case by case basis depending upon experience of use of the product, and defined in specific contractual documents.

Requirements for the declaration of the potential of railway ballast to release regulated dangerous substances are currently under development. Until such time as these are finalised, attention should be paid to requirements at the place of use.

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 932-1:1996, *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 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 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 1097-6, *Tests for mechanical and physical properties of aggregates — Part 6: Determination of particle density and water absorption*

EN 1367-1:2007, *Tests for thermal and weathering properties of aggregates — Part 1: Determination of resistance to freezing and thawing*

EN 1367-2:2009, *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 1367-6, *Tests for thermal and weathering properties of aggregates — Part 6: Determination of resistance to freezing and thawing in the presence of salt (NaCl)*

EN 16236:2013, *Evaluation of conformity of aggregates — Initial Type Testing and Factory Production Control*

3 Terms and definitions

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

3.1
aggregate
granular material used in construction

Note 1 to entry: Aggregates may be natural, manufactured or recycled.

3.2
railway ballast
aggregate where 100 % of the surface of the particles can be described as totally crushed used in the construction of the upper layer of railway track, with sizes e. g. 22/40 mm, 31,5/50 mm or 31,5/63 mm

3.3
natural railway ballast
aggregate for railway ballast from mineral sources which have been subjected to nothing more than mechanical processing

Note 1 to entry: Natural railway ballast should be produced without blending material from different geological sources.

3.4
manufactured railway ballast
railway ballast of mineral origin resulting from an industrial process involving thermal or other modification

3.5
recycled railway ballast
railway ballast resulting from the processing of inorganic or mineral material previously used in construction

3.6
category
level of a property of railway ballast expressed as a range of values or a limiting value

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

3.7
railway ballast size
designation of railway ballast in terms of lower (d) and upper (D) sieve sizes expressed as d/D

Note 1 to entry: This designation accepts the presence of some particles which are retained on the upper sieve (oversize) and some which pass the lower sieve (undersize)

3.8
fine particles
particle size fraction of railway ballast which passes the 0,5 mm sieve

3.9
fines
particle size fraction of railway ballast which passes the 0,063 mm sieve

4 Geometrical requirements

4.1 General

The necessity for testing and declaring all properties specified in this clause shall be limited according to the particular application at end use or origin of the railway ballast. When required, the tests in Clause 4 specified shall be carried out to determine appropriate geometrical properties.

When the value of a property is required but not defined by specified limits the value should be declared as an $XX_{Declared}$ category, e.g. in Table 4 a value of say 40 for the flakiness index corresponds to FI_{RB40} *(Declared value)*.

NOTE 1 When a property is not required, a “No requirement” category can be used.

NOTE 2 Guidance on selection of appropriate categories for specific applications can be found in national provisions in the place of use of the railway ballast.

NOTE 3 Where conformity with a category is based on a value of a property being less than or equal to a given value, conformity with a more severe category (lower value) automatically confers conformity with all less severe categories (higher values). Similarly for categories based on the value of a property being greater than or equal to a given value, conformity with a more severe (higher value) automatically confers conformity with all less severe categories (lower values).

Sampling shall be carried out in accordance with EN 932-1.

NOTE 4 Advice on sampling from a wagon or the track at the laying site is given in Annex A.

NOTE 5 Guidance on interpretation of results when samples of railway ballast have been taken from railway wagon or out of track is given in Annex B.

4.2 Railway ballast size

Railway ballast size shall be specified using a pair of sieve sizes in millimetre with *d* as the lower limit designation sieve and *D* as the upper limit designation sieve between which most of the particle size distribution lies.

4.3 Grading

The grading of the railway ballast shall be determined in accordance with EN 933-1 and the results declared in accordance with the relevant category specified in Table 1.

Table 1 — Categories for grading

Sieve size mm	Railway ballast size 31,5 mm to 50 mm	Railway ballast size 31,5 mm to 63 mm			Railway ballast size 22 mm to 40 mm
	Percentage passing by mass				
	Grading category				
	G_C RB A	G_C RB B	G_C RB C	G_C RB D	G_C RB E
80	100	100	100	100	-
63	100	95 to 100	95 to 100	93 to 100	-
50	70 to 99	65 to 99	55 to 99	45 to 70	100
40	30 to 65	30 to 65	25 to 75	15 to 40	90 to 100
31,5	1 to 25	1 to 25	1 to 25	0 to 7	60 to 98
22,4	0 to 3	0 to 3	0 to 3	0 to 7	15 to 60
16	-	-	-	-	0 to 15
8	-	-	-	-	0 to 2
31,5 to 50	≥ 50	-	-	-	-
31,5 to 63	-	≥ 50	≥ 50	≥ 85	-

NOTE The requirement for passing the 22,4 mm sieve applies to railway ballast sampled at the place of production.

In certain circumstances a 25 mm sieve may be used as an alternative to the 22,4 mm sieve, when a tolerance of 0 to 5 would apply.

When assessing production within a system of FPC, at least 90 % of gradings, taken on different batches within a maximum period of 6 months, shall fall within the limits specified in Table 1.

4.4 Content of fine particles

The content of fine particles shall be determined in accordance with EN 933-1 and the results declared in accordance with the relevant category specified in Table 2.

Table 2 — Categories for fine particles content

Sieve size mm	Maximum percentage passing by mass			
	Fine particle category			
	G_F **RB** A	G_F **RB** B	G_F **RB** Declared	G_F **RB** C
0,5	0,6	1,0	> 1,0	No requirement

NOTE The requirement applies to railway ballast sampled at the place of production.

4.5 Fines content

The fines content shall be determined in accordance with EN 933-1 and the results declared in accordance with the relevant category specified in Table 3.

When required, cleanliness shall be assessed from the fines content. Fines shall be considered non-harmful if the total fines content is less than the relevant category specified in Table 3 in accordance with the provisions valid in the place of use of the aggregate.

Table 3 — Categories for fines content

Sieve size	Maximum percentage passing by mass				
	Fines content category				
mm	f_{RB} A	f_{RB} B	f_{RB} C	f_{RB} Declared	f_{RB} D
0,063	0,5	1,0	1,5	> 1,5	No requirement
NOTE The requirement applies to railway ballast sampled at the place of production.					

4.6 Particle shape - Flakiness index and shape index

When required, the shape of railway ballast shall be determined in accordance with EN 933-3 in terms of the flakiness index and the results declared in accordance with the relevant category specified in Table 4.

The flakiness index shall be the reference test for the determination of the shape.

Table 4 — Categories for maximum values of flakiness index

Flakiness Index	Category FI_{RB}
≤ 15	FI_{RB} 15
≤ 20	FI_{RB} 20
≤ 25	FI_{RB} 25
4 to 25	FI_{RB} 4/25
> 25	FI_{RB} Declared
No requirement	FI_{RB} NR

When required, the shape index of railway ballast shall be determined in accordance with EN 933-4 and the results declared in accordance with the relevant category specified in Table 5.

Table 5 — Categories for maximum values of shape index

Shape Index	Category SI_{RB}
≤ 10	SI_{RB} 10
≤ 20	SI_{RB} 20
≤ 30	SI_{RB} 30
5 to 30	SI_{RB} 5/30
> 30	SI_{RB} Declared
No requirement	SI_{RB} NR

4.7 Particle length

Particle length of railway ballast shall be assessed by measuring with an appropriate gauge or callipers.

Limits should be selected from the specified range until such a time as there is more data available on railway ballast properties related to performance.

When required, the particle length of railway ballast shall be determined and the results declared in accordance with the relevant category specified in Table 6.

Table 6 — Categories for maximum values of particle length

Percentage by mass with length ≥ 100 mm in a greater than 40 kg sample					
Particle length category					
L_{RB} A	L_{RB} B	L_{RB} C	L_{RB} D	L_{RB} Declared	L_{RB} E
≤ 4	≤ 6	≤ 8	≤ 12	> 12	No requirement

5 Physical requirements

5.1 General

The necessity for testing and declaring all properties specified in this clause shall be limited according to the particular application at end use or origin of the railway ballast. When required, the tests specified in Clause 5 shall be carried out to determine appropriate physical properties.

When the value of a property is required but not defined by specified limits the value should be declared as an $XX_{Declared}$ category, e.g. in Table 7 a Los Angeles coefficient of say 30 corresponds to LA_{RB} 30*(Declared value)*.

NOTE 1 When a property is not required, a “No requirement” category can be used.

NOTE 2 Guidance on selection of appropriate categories for specific applications can be found in national provisions in the place of use of the railway ballast.

NOTE 3 Where conformity with a category is based on a value of a property being less than or equal to a given value, conformity with a more severe category (lower value) automatically confers conformity with all less severe categories (higher values). Similarly for categories based on the value of a property being greater than or equal to a given value, conformity with a more severe (higher value) automatically confers conformity with all less severe categories (lower values).

5.2 Resistance to fragmentation

5.2.1 Los Angeles

When required, the resistance to fragmentation of railway ballast shall be determined in terms of the Los Angeles coefficient as specified in EN 1097-2, using the conditions as specified in Annex A, and the results declared in accordance with the relevant category specified in Table 7.

Table 7 — Categories for maximum values of Los Angeles coefficient

Los Angeles coefficient	Category LA_{RB}
≤ 12	LA_{RB} 12
≤ 14	LA_{RB} 14
≤ 16	LA_{RB} 16
≤ 20	LA_{RB} 20
≤ 22	LA_{RB} 22
≤ 24	LA_{RB} 24
> 24	LA_{RB} Declared
No requirement	LA_{RB} NR

5.2.2 Resistance to impact

Where required, the impact value of railway ballast shall be determined in accordance with EN 1097-2, using the conditions as specified in Annex A, and the results declared in accordance with the relevant category specified in Table 8.

Table 8 — Categories for maximum values of resistance to impact

Impact value %	Category SZ_{RB}
≤ 14	SZ_{RB} 14
≤ 18	SZ_{RB} 18
≤ 20	SZ_{RB} 20
≤ 22	SZ_{RB} 22
> 22	SZ_{RB} Declared
No requirement	SZ_{RB} NR

5.3 Resistance to wear

When required, the resistance to wear of railway ballast shall be determined in accordance with EN 1097-1, using the conditions as specified in Annex A, and the results declared in accordance with the relevant category specified in Table 9.

Table 9 — Categories for maximum values of resistance to wear

micro-Deval coefficient	Category M_{DE} RB
≤ 5	M_{DE} RB 5
≤ 7	M_{DE} RB 7
≤ 9	M_{DE} RB 9
≤ 11	M_{DE} RB 11
≤ 13	M_{DE} RB 13
≤ 15	M_{DE} RB 15
> 15	M_{DE} RB Declared
No requirement	M_{DE} RB NR

5.4 Particle density and water absorption

5.4.1 Particle density

When required, the particle density shall be determined in accordance with EN 1097-6 (apparent density) and the results declared.

5.4.2 Water absorption

When required, the water absorption shall be determined in accordance with EN 1097-6 depending upon the size of the railway ballast and the results declared.

6 Chemical requirements

6.1 General

Railway ballast shall not contain other components or matter than specified in this standard.

6.2 Petrographic description

When required, the petrographic description of railway ballast shall be determined and described in accordance with EN 932-3 and the results declared.

7 Durability

7.1 General

The necessity for testing and declaring all properties specified in this clause shall be limited according to the particular application at end use or origin of the railway ballast. When required, the tests specified in Clause 7 shall be carried out to determine appropriate properties for the durability of railway ballast.

NOTE Where conformity with a category is based on a value of a property being less than or equal to a given value, conformity with a more severe category (lower value) automatically confers conformity with all less severe categories (higher values). Similarly for categories based on the value of a property being greater than or equal to a given value, conformity with a more severe (higher value) automatically confers conformity with all less severe categories (lower values).

7.2 Magnesium sulfate soundness

When required, the resistance to weathering of railway ballast shall be determined in accordance with the magnesium sulfate soundness test in EN 1367-2, using the conditions as specified in Annex C, and the results declared in accordance with the relevant category specified in Table 10.

Table 10 — Categories for maximum magnesium sulfate soundness

Magnesium sulfate value Percentage loss of mass	**Category** MS_{RB}
≤ 3	MS_{RB} 3
≤ 6	MS_{RB} 6
> 6	MS_{RB} Declared
No requirement	MS_{RB} NR

7.3 Freeze-thaw resistance

7.3.1 Water absorption as a screening test for freeze-thaw resistance

When required, the water absorption value as a screening test shall be determined in accordance with the procedures specified in EN 1097-6 and the result declared.

If the water absorption, determined in accordance with EN 1097-6 (water absorption of railway ballast saturated to constant mass), is not greater than 0,5, the railway ballast shall be assumed to be freeze thaw resistant.

If the water absorption, determined in accordance with EN 1097-6 (water absorption of railway ballast saturated to constant mass), is greater than 0,5, then the resistance to freezing and thawing shall be determined in accordance with 7.3.2 or 7.3.3.

NOTE With some railway ballast containing a proportion of porous flint aggregate sources the differentiation between satisfactory and unsatisfactory freeze-thaw durability can be better assessed by density measurements rather than water absorption.

7.3.2 Resistance to freezing and thawing

When required, the resistance to freezing and thawing shall be determined in accordance with EN 1367-1, using the conditions as specified in Annex D, and the results declared in accordance with the relevant category specified in Table 11.

Table 11 — Categories for maximum freeze-thaw resistance values

Freeze-thaw Percentage loss of mass	**Category** F_{RB}
≤ 1	F_{RB} 1
≤ 2	F_{RB} 2
≤ 4	F_{RB} 4
> 4	F_{RB} Declared
No requirement	F_{RB} NR

7.3.3 Resistance to freezing and thawing in the presence of salt (extreme conditions)

When required (see Note below), the resistance to freezing and thawing shall be determined in accordance with EN 1367-6 and the results declared in accordance with the relevant category specified in Table 12. In this case, the resistance to freezing and thawing (see 7.3.2.) shall not be determined.

NOTE The results of this test provide a means for assessing an aggregate's resistance to frost weathering in areas where frequent freeze-thaw cycling occurs with seawater sprays or abundant de-icers conditions, and where result values of EN 1367-1 test method do not describe correctly aggregate performance in extreme conditions.

This test has been found to be appropriate for certain petrographic types of aggregate (e.g. basalts) under severe conditions of use and may not be universally applicable to all rock types.

Table 12 — Categories for maximum freeze-thaw resistance in the presence of salt

Freeze-thaw Percentage loss of mass	**Category** F_{EC} RB
≤ 2	F_{EC} RB 2
≤ 4	F_{EC} RB 4
≤ 5	F_{EC} RB 5
≤ 6	F_{EC} RB 6
≤ 8	F_{EC} RB 8
> 8	F_{EC} RB Declared
No requirement	F_{EC} RB NR
NOTE When tests using de-icing solutions other than NaCl, the limits of Table 12 would not apply.	

7.4 Electrical conductivity

When required, the electrical conductivity of railway ballast shall be determined.

Requirements for the declaration of the electrical conductivity of railway ballast are currently under development. Until such time as these are finalised attention should be paid to requirements at the place of use.

7.5 Sonnenbrand

Where signs of "Sonnenbrand" are known the loss of mass and the resistance to fragmentation shall be determined in accordance with EN 1367-3 and EN 1097-2.

NOTE "Sonnenbrand" is a type of rock decay that can be present in some basalts and manifests itself under the influence of atmospheric conditions. It starts with the appearance of grey/white coloured spots. Usually hairline cracks are generated radiating out from the spots and interconnecting them. This reduces the strength of the mineral fabric, and as a result the rock decays to small particles. Depending on the source this process can take place within months of extraction or extend over several decades. In exceptional cases, a rapid decay results in the formation of large cracks and the breaking of aggregate particles.

On completion of the boiling test, the loss of mass and the resistance to fragmentation (SB_{RB} SZ or SB_{RB} LA) shall be declared in accordance with the relevant category specified in Table 13.

Table 13 — Categories for maximum values of resistance to "Sonnenbrand"

Test Method	Result	Value	Category SB_{RB}
Boiling test	Loss of mass after boiling	≤ 1	
And either			
a) Impact test	Increase of impact value after boiling	≤ 3	SB_{RB} SZ
or			
b) Los Angeles test	Increase of Los Angeles coefficient after boiling	≤ 5	SB_{RB} LA
Boiling test	Loss of mass after boiling	> 1	
And either			
a) Impact test	Increase of impact value after boiling	> 3	SB_{RB} SZ Declared
or			
b) Los Angeles test	Increase of Los Angeles coefficient after boiling	> 5	SB_{RB} LA Declared
No requirement			SB_{RB} NR

8 Evaluation of conformity

The producer shall undertake Initial Type Tests and Factory Production Control in accordance with EN 16236 to ensure that the product conforms to this European Standard and to declared values as appropriate.

9 Designation

9.1 Designation and description

Railway ballast shall be identified in the following terms:

a) source and producer - if the material has been re-handled in a depot both source and depot shall be given; in the case of recycled railway ballast, the source / plant / site / track where it has been taken from shall be given;

b) a simple indication of the petrographic type (see EN 932-3);

c) railway ballast size.

9.2 Additional information for the description of railway ballast

The necessity for other information depends on the situation and end use, for example:

a) a code to relate the designation to the description;

b) any other additional information needed to identify the particular railway ballast.

The producer should be informed at the time of order of any special requirements associated with a particular end use and of requirements for extra information not covered in Table ZA.1a and Table ZA. 1b.

10 Marking and labelling

The delivery ticket shall contain at least the following information:

a) designation;

b) date of despatch;

c) serial number of the ticket;

d) number of this European Standard.

NOTE For CE marking and labelling see ZA.3.

Annex A
(informative)

Sampling railway ballast at the construction site either from a railway wagon or from the track

A.1 Introduction

It is intended that for compliance purposes railway ballast should be sampled only at the place of production. The specification limits contained within this standard are based on the testing of samples taken at this location. The method of sampling should be as specified in EN 932-1.

However there will be occasions when it will be necessary to take a sample of railway ballast at the time of delivery or from the track. Reasons can include to check if degradation has occurred during transport or to investigate a particular track problem. In such situations one of the following sampling procedures should be adopted.

A.2 Sampling railway ballast from a railway wagon

A.2.1 Sampling of railway ballast at a construction site should be carried out in accordance with the principles and definitions specified in EN 932-1.

A.2.2 Sampling should only be carried from a fully loaded wagon by use of a sampling box (see EN 932-1:1996, Figure 5) of inner dimensions length 700 mm, width 450 mm and height 250 mm.

A.2.3 All the increments for one bulk sample should be taken from one wagon and from one discharge opening (slide or conveyor belt) of that wagon.

A.2.4 A minimum of four increments should be taken.

A.2.5 The first increment should be taken about 10 s after the commencement of unloading, the last increment about 10 s before the end of unloading and intermediate increments at regular intervals in between the first and last.

A.2.6 The discharge opening should be completely open at the time of sampling.

A.2.7 The wagon should move at walking pace (about 3 km/h) over the sampling box.

A.2.8 The contents of one sample box should constitute one increment.

A.2.9 The increments should be mixed together to form a bulk sample on a clean flat surface or on a thick tear resistant plastic sheet.

A.2.10 The bulk sample should be split into the required number of subsamples in accordance with EN 932-1.

A.3 Sampling railway ballast from track without use of a steel frame

A.3.1 The bulk sample should consist of one or more spaces between sleepers.

A.3.2 If it is required to sample railway ballast from more than one space between sleepers then the first, fourth and then every third space should be sampled.

A.3.3 The railway ballast should be removed completely first by using a ballast fork and then a small shovel or similar.

A.3.4 The railway ballast should be removed down to the bottom of the railway ballast layer. Care should be taken to ensure that no damage is caused to the formation or the protective layer and that no particles originating from them are included in the sample.

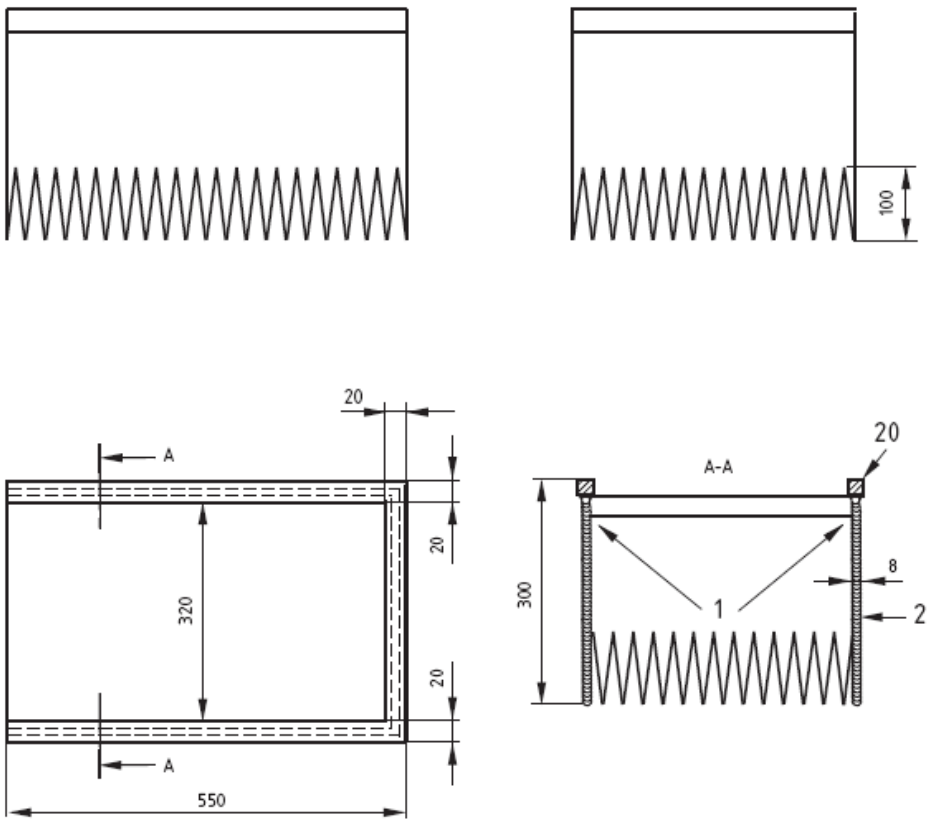
A.3.5 The increments should be mixed together to form a bulk sample on clean, flat surface or on thick tear-resistant plastic sheet.

A.3.6 The bulk sample should be split into the required number of subsamples, in accordance with EN 932-1.

A.4 Sampling railway ballast from track using a steel frame

A.4.1 A steel frame serrated at its lower edge, as shown in Figure A.1, can be used for railway ballast sampling from the track.

Dimensions in millimetres



Key

1 welding seam
2 steel plate

Figure A.1 — Frame for sampling railway ballast

A.4.2 The sampling procedure should be as described in A.3 except that at each space between sleepers from which it is required to take a sample, the steel frame should be driven into the railway ballast using a sledge hammer. The steel frame should be driven between concrete sleepers without damaging the sleepers.

A.4.3 Railway ballast should be removed first with a ballast fork and the frame then driven deeper into the railway ballast. Removal of the bottom layer of railway ballast should be with a small shovel or similar. Care should be taken to ensure that no damage is caused to the formation or the protective layer and that no particles originating from them are included in the sample.

A.4.4 The increments should be mixed together to form a bulk sample on a clean, flat surface or thick tear-resistant plastic sheet.

A.4.5 The bulk sample should be split into the required number of subsamples, in accordance with EN 932-1.

Table A.1 — Inventory list with classification codes and status for source materials for EN 13450 railway ballast *(1 of 2)*

Nr.	Source	Subnr.	Specific material	History of use	Special requirements in standard	Additional requirements identified for inclusion
P	Natural aggregates	P	All petrographic types included in EN 932-3	Yes	Yes	No
A	Construction and demolition recycling industries	A1	Reclaimed asphalt	No	--	--
		A2	Crushed concrete	No	–	–
		A3	Crushed bricks, masonry	No	–	–
		A4	Mix of A1, A2 and A3	No	–	–
B	Municipal solid waste incineration industry	B1	Municipal incinerator bottom ash[a] (excluding fly ash) (MIBA)	No	--	--
		B2	Municipal incinerator fly ash (MIFA)	No	--	--
C	Coal Power generation industry	C1	Coal fly ash	No	--	--
		C2	Fluidized bed combustion fly ash (FBCFA)	No	--	--
		C3	Boiler slag	No	--	--
		C4	Coal bottom ash	No	–	–
		C5	Fluidized bed combustion bottom ash (FBC bottom ash)	No	–	–

Table A.1 *(2 of 2)*

Nr.	Source	Subnr.	Specific material	History of use	Special requirements in standard	Additional requirements identified for inclusion
D	Iron and steel industry	D1	Granulated blast furnace slag (GBS) (vitrified)	No	–	–
		D2	Air-cooled blast furnace slag (ABS) (crystallized)	No	--	--
		D3	Basic oxygene furnace slag (converter slag, BOS)	No	--	--
		D4	Electric arc furnace slag (from carbon steel production, EAF C)	No	--	--
		D5	Electric arc furnace slag (from stainless/high alloy steel production, EAF S)	No	--	--
		D6	Ferrochromium slag	No	--	--
E	Non ferrous metal industry	E1	Copper slag	No	--	--
		E2	Molybdenum slag	No	--	--
		E3	Zinc slag	No	–	–
		E4	Phosphorus slag	No	--	--
F	Foundry industry	F1	Foundry sand	No	--	--
		F2	Foundry cupola furnace slag	No	--	--
G	Mining and quarry industry	G1	Red coal shale	No	–	–
		G2	Refuse from hard coal mining (black coal shale)	No	–	–
		G3	Pre-selected all-in from quarry/mining	No	–	–
		G4	Spent oil shale	No	–	–
H	Maintenance dredging works	H1	Dredge spoil sand	No	–	–
		H2	Dredge spoil clay	No	–	–
I	Miscellaneous	I1	Excavated soil	No	–	–
		I2	Paper sludge ash	No	--	--
		I3	Sewage sludge incineration ash (municipal)	No	--	--
		I4	Biomass ash	No	--	--
		I5	Crushed glass	No	--	--
		I6	Expanded clay	No	–	–

a Requirements on MSWI bottom ash are based on experience with grated installations.

Annex B
(informative)

Guidance on interpretation of results when samples of railway ballast have been taken from railway wagon or from track

B.1 For assessment of compliance with specification samples should be taken at the place of production in accordance with EN 932-1, tested in accordance with the test methods detailed in this standard and compared with the appropriate specified values.

B.2 There will however be some occasions when samples are taken from a railway wagon or from the track. In such cases the same test methods and appropriate specified values should apply with the exception of certain test methods which can be used to assess if degradation of the railway ballast has occurred in transport.

B.3 For these tests, the results obtained from samples taken from a railway wagon or from the track should be compared with the limits given in Table B.1 and provided these are not exceeded the degradation of the railway ballast during transport or by attrition may be considered acceptable.

B.4 Results of sample, which are taken from the railway track before tamping, are for information purposes and to form the basis of discussion between the supplier and the customer.

Table B.1 — Degradation of railway ballast during transport

Test clause	Description	Category		
		A	B	C
6.2	Maximum percentage by mass passing 22,4 mm sieve	5	7	No requirement
6.2	Maximum percentage by mass passing 25 mm sieve	6	8	No requirement

Annex C
(normative)

Conditions to be applied to the test procedure specified in EN 1367-2 for the determination of the resistance of railway ballast to the magnesium sulfate test (see 7.2)

C.1 General

The test shall be carried out as specified in EN 1367-2 for the assessment of how railway ballast behaves when subject to a magnesium sulfate test with the following conditions of use applied to the procedures.

C.2 Apparatus

Under EN 1367-2:2009, Clause 6:

a) in EN 1367-2:2009, 6.1, the 10 mm and 14 mm sieve sizes are replaced by 22,4 mm, 31,5 mm, 40 mm and 50 mm sieve sizes;

b) in EN 1367-2:2009, 6.2, the capacity of the balance of 2 kg , accurate to 0,1 g, is replaced by 20 kg, accurate to 1 g;

c) in EN 1367-2:2009, 6.3 and Figure 1, the basket shall have a mesh size of 4 mm and its dimensions shall be 260 mm deep with a diameter of 230 mm.

C.3 Reagents

Under EN 1367-2:2009, Clause 7, 12 l of saturated solution of magnesium sulfate is required for each test.

C.4 Preparation of test specimens

Under EN 1367-2:2009, Clause 8, the two test specimens required shall each have a mass of (10 000 ± 100) g consisting of (5000 ± 50) g of the 31,5 mm to 40 mm aggregate size and (5000 ± 50) g of the 40 mm to 50 mm aggregate size.

Under EN 1367-2:2009, 8.3, each test specimen shall be sieved on the 22, 4 mm sieve.

C.5 Procedure

Under EN 1367-2:2009, Clause 9:

a) in EN 1367-2:2009, 9.4, the process shall be repeated for 10 cycles;

b) in EN 1367-2:2009, 9.6, hand sieve on the 22,4 mm sieve.

C.6 Calculation and expression of results

Under EN 1367-2:2009, Clause 10, M_2 shall be the mass retained on the 22,4 mm sieve to the nearest 1 g.

C.7 Test report

Report that the test procedure was carried out in accordance with EN 1367-2, applying the conditions of use as specified in this annex.

Annex D
(normative)

Conditions to be applied to the test procedure specified in EN 1367-1 for determination of the resistance to freezing and thawing of railway ballast (see 7.3.2)

D.1 General

The test shall be carried out as specified in EN 1367-1 for the determination of resistance to freezing and thawing with the following conditions of use applied to the procedures.

D.2 Exposure to freezing under water

Under EN 1367-1:2007, 8.2 subject the samples in the cabinet to a series of 20 freeze-thaw cycles, instead of 10 freeze-thaw cycles.

D.3 Test report

Report that the test procedure was carried out in accordance with EN 1367-1, applying the conditions of use as specified in this annex.

Annex E
(normative)

Source materials considered in the development of EN 13450 and their status in respect of the scope of this standard

The source types listed in this annex have been considered in the preparation of this standard. Their status within the standard is indicated in Table A.1. Source materials not described here are outside the scope of EN 13450.

Sources with no history of use as railway ballast are outside the scope of the standard.

Sources with positive history of use and no identification of the need for additional requirements are fully within the scope of the standard.

Sources with a positive history of use and where the need for additional requirements has been identified are provisionally within scope pending the inclusion of suitable test methods and requirements.

In all cases, there is an obligation to control the potential release of regulated dangerous substances (RDS) in accordance with Member State requirements at the place of use.

The information in this annex is based on a comprehensive survey of the use of aggregates from secondary sources in European member states undertaken between 2000 and 2005. CEN/TC154 intends to keep this inventory under continual review. Any relevant information to assist in the updating of this annex including any proposal for the inclusion of new source types should be submitted to the secretariat of CEN/TC154.

In situations where the need for additional requirements has been identified, such materials, when placed on the market as railway ballast, should comply fully with this standard but may also be required to comply with specific relevant additional requirements at the place of use. Additional characteristics and requirements may be specified on a case by case basis depending upon experience of use of the product, and defined in specific contractual documents.

Under an extension to its Mandate, CEN/TC154 is currently developing requirements for the declaration of the potential of aggregates to release regulated dangerous substances under Essential Requirement 3. It is anticipated that the source classifications in this annex will be used as the basis of families for the collation of data and the development of source specific requirements for regulated dangerous substances. Any input to this process should be made through the secretariat of CEN/TC 154.

Annex ZA
(informative)

Clauses of this European Standard addressing the provisions of the EU Construction Products Directive

ZA.1 Scope and relevant characteristics

This European Standard and this annex ZA have been prepared under a mandate[1] given to CEN by the European Commission and the European Free Trade Association.

The clauses of this European Standard shown in this annex meet the requirements of the Mandate given under the EU Construction Products Directive (89/106/EEC).

Compliance with these clauses confers a presumption of fitness of the aggregates covered by this European Standard for their intended uses indicated herein; reference shall be made to the information accompanying the CE marking.

This annex establishes the conditions for the CE marking of the aggregates for railways ballast intended for the uses indicated in Table ZA.1 and shows the relevant clauses applicable.

This annex has the same scope as the relevant part in Clause 1 of this standard related to the aspect covered by the mandate and is defined by Table ZA.1.

Table ZA.1 – Scope and relevant requirement clauses

Product: Aggregates obtained by processing natural, manufactured or recycled crushed unbound aggregates as covered by the scope of this standard **Intended use(s):** Railway ballast for use in construction of the upper layer of railway track			
Essential Characteristics	**Requirement clauses in this and/or another standard(s)**	**Level(s) and/or class(es):**	**Notes**
Particle shape, size and density	4.2 Railway ballast size	None	Designation *d* and *D*
	4.3 Grading	None	Category
	4.6 Particle shape	None	Category
	4.7 Particle length	None	Category
	5.4 Particle density and water absorption	None	Declared
Resistance to fragmentation	5.2 Resistance to fragmentation	None	Category
Resistance to attrition	5.3 Resistance to wear	None	Category
Cleanliness	4.5 Fines content	None	Category

[1] M125 "Aggregates", as amended.

Table ZA.1 *(2 of 2)*

Product: Aggregates obtained by processing natural, manufactured or recycled crushed unbound aggregates as covered by the scope of this standard **Intended use(s):** Railway ballast for use in construction of the upper layer of railway track			
Essential Characteristics	**Requirement clauses in this and/or another standard(s)**	**Level(s) and/or class(es):**	**Notes**
Electrical conductivity	7.4 Electrical conductivity	None	Declared
Petrographic description	6.2 Petrographic description	None	Declared
Dangerous substances	EN 16236:2013, 5.3.4 Knowledge of the raw material EN 16236:2013, 5.3.5 Management of the production		
Emission of radioactivity		None	
Release of heavy metals		None	
Release of polyaromatic carbons			
Release of other dangerous substances		None	
Durability	7.3.2 Resistance to freezing and thawing	None	Category
Freeze-thaw resistance	7.3.3 Resistance to freezing and thawing in the presence of salt (extreme conditions)	None	Category
Durability against weathering	7.2 Magnesium sulfate soundness	None	Category
	7.5 Sonnenbrand	None	Category

The requirement on a certain characteristic is not applicable in those Member States (MSs) where there are no regulatory requirements on that characteristic for the intended use of the product. In this case, producers placing their products on the market of these MSs are not obliged to determine nor declare the performance of their products with regard to this characteristic and the option “No performance determined” (NPD) in the information accompanying the CE marking (see ZA.3) may be used. The NPD option may not be used, however, where the characteristic is subject to a threshold level.

ZA.2 Procedures for attestation of conformity of aggregates

ZA.2.1 System(s) of attestation of conformity

The systems of attestation of conformity for the aggregates indicated in Table ZA.1, in accordance with the decision of the Commission 98/598/EC of 9 October 1998 amended by the Commission Decision 2002/592/EC of 15 July 2002 (Official Journal L192) and as given in annex 3 of the mandate M125 “Aggregates”, as amended, is shown in Tables ZA.2a and ZA.2b for the indicated intended use(s):

Table ZA.2a – System(s) of attestation of conformity for aggregates for uses with high safety requirements[2] (where third party intervention is required)

Product(s)	Intended use(s)	Level(s) or class(es)	Attestation of conformity system(s)
Railway ballast	For railway works	-	2+
System 2+: See Directive 89/106/EEC (CPD) Annex III.2.(ii), First possibility, including certification of the factory production control by an approved body on the basis of initial inspection of factory and of factory production control as well as of continuous surveillance, assessment and approval of factory production control			

Table ZA.2b – System(s) of attestation of conformity for aggregates for uses without high safety requirements[2] where no third party intervention is required

Product(s)	Intended use(s)	Level(s) or class(es)	Attestation of conformity system(s)
Railway ballast	For railway works	-	4
System 4: See Directive 89/106/EEC (CPD) Annex III.2.(ii), Third possibility			

The attestation of conformity of the aggregates in Table ZA.1 shall be based on the evaluation of conformity procedures indicated in Tables ZA.3a and Table ZA.3b resulting from application of the clauses of this European Standard indicated therein.

Table ZA.3a – Assignation of evaluation of conformity tasks (for aggregates under system 2+)

Tasks			Content of the task	Evaluation of conformity clauses to apply
Tasks for the producer	Factory production control (F.P.C)		Parameters related to all relevant characteristics of Table ZA.1	Clauses 8 and 5 of EN 16236:2013
	Initial type testing		All relevant characteristics of Table ZA.1	Clauses 8 and 4 of EN 16236:2013
Tasks for the notified body	Certification of F.P.C on the basis of	Initial inspection of factory and of F.P.C	Parameters related to all relevant characteristics of Table ZA.1	Clauses 8 and 5 of EN 16236:2013
		Continuous surveillance, assessment and approval of F.P.C.	Parameters related to all relevant characteristics of Table ZA.1	Clauses 8 and 5 of EN 16236:2013
Further testing of samples taken at factory according to the prescribed test plan			Essential characteristics of Table ZA.1 relevant for the intended use which are declared	Clause 5 of EN 16236:2013

[2] Safety requirements are to be defined by Member States in their national laws, regulations and administrative provisions.

Table ZA.3b – Assignation of evaluation of conformity tasks (for aggregates under system 4)

Tasks		Content of the task	Evaluation of conformity clauses to apply
Tasks for the producer	Factory production control (F.P.C)	Parameters related to all relevant characteristics of Table ZA.1	Clause 5 of EN 16236:2013
	Initial type testing	All relevant characteristics of Table ZA.1	Clause 4 of EN 16236:2013

ZA.2.2 EC certificate and Declaration of conformity

For aggregates under system 2+*:* When compliance with the conditions of this annex is achieved, and once the notified body has drawn up the certificate mentioned below, the manufacturer or his agent established in the EEA shall prepare and retain a declaration of conformity, which entitles the manufacturer to affix the CE marking. This declaration shall include:

— name and address of the manufacturer, or his authorised representative established in the EEA, and the place of production;

NOTE 1 The manufacturer may also be the person responsible for placing onto the EEA market, if he takes responsibility for CE marking.

— description of the product (type, identification, use, …), and a copy of the information accompanying the CE marking;

NOTE 2 Where some of the information required for the Declaration is already given in the CE marking information, it does not need to be repeated.

— provisions to which the product conforms (annex ZA of this EN); and a reference to ITT report (s) and factory production control records (if appropriate);

— particular conditions applicable to the use of the product (e.g. provisions for use under certain conditions, etc);

— the number of the accompanying factory production control certificate, and FPC records where applicable;

— name of, and position held by, the person empowered to sign the declaration on behalf of the manufacturer or his authorised representative.

The declaration shall be accompanied by a factory production control certificate, drawn up by the notified body, which shall contain, in addition to the information above, the following:

— name and address of the notified body;

— the number of the factory production control certificate;

— conditions and period of validity of the certificate, where applicable;

— name of, and position held by, the person empowered to sign the certificate.

The above mentioned declaration shall be presented in the official language or languages of the Member State in which the product is to be used.

For aggregates under system 4*):* When compliance with this annex is achieved, the producer or his agent established in the EEA shall draw up and retain a declaration of conformity (EC Declaration of conformity), which entitles the producer to affix of the CE marking. This declaration shall include:

— name and address of the producer, or his authorised representative established in the EEA, and place of production;

NOTE 3 The manufacturer may also be the person responsible for placing onto the EEA market, if he takes responsibility for CE marking.

— description of the product (type, identification, use,...), and a copy of the information accompanying the CE marking;

NOTE 4 Where some of the information required for the Declaration is already given in the CE marking information, it does not need to be repeated.

— provisions to which the product conforms (Annex ZA of this EN);

— particular conditions applicable to the use of the product (e.g. provisions for use under certain conditions, etc.);

— name of, and position held by, the person empowered to sign the declaration on behalf of the producer or of his authorised representative.

The above mentioned EC declaration of conformity or the EC certificate of conformity shall be presented in the language or languages accepted in the Member State in which the product is to be used.

ZA.3 CE marking and labelling

The manufacturer or his authorised representative established within the EEA is responsible for the affixing of the CE marking. The CE marking symbol to affix shall be in accordance with Directive 93/68/EEC and shall be shown on the accompanying label, the packaging or on the accompanying commercial documents e.g. a delivery note. The following information shall accompany the CE marking symbol:

— identification number of the certification body (only for products under system 2+);

— name or identifying mark and registered address of the producer;

— the last two digits of the year in which the marking is affixed;

— number of the certificate of factory production control (only for products under system 2+);

— reference to this European Standard with date of version (EN 13450:2013);

— description of the product: generic name, material, dimensions, … and intended use;

— information on the relevant essential characteristics in Tables ZA.1, namely:

— values and, where relevant, the class to declare for each relevant characteristic

— characteristics against which the “No performance determined” (NPD) option is relevant.

The “No performance determined” (NPD) option may not be used where the characteristic is subject to a threshold level. Otherwise, the NPD option may be used when and where the characteristic, for a given intended use, is not subject to regulatory requirements.

Figures ZA.1 and ZA.2 give examples of the information to be given on the label, packaging and/or commercial documents.

CE		*CE conformity marking, consisting of the "CE"-symbol given in directive 93/68/EEC.*
01234		*Identification number of the inspection body*
Any Co Ltd, PO Box 21, B-1050		*Name or identifying mark and registered address of the producer*
13		*Last two digits of the year in which the marking was affixed*
0123-CPD-0456		*Number of the EC certificate*
EN 13450:2013		*No. of European Standard*
Aggregates for railway ballast		*Description of product and* *information on product and on regulated characteristics*
Particle shape	Category (e.g. $FI_{RB\ 15}$)	
Particle size	Designation (*d* & *D*) & Category (e.g. B)	
Particle length	Category (PL.)	
Particle density	Declared value (Mg/m^3)	
Resistance to fragmentation / crushing	Category (e.g. $LA_{RB}18$) Category (e.g . SZ_{RB} 18)	
Resistance to attrition	Category (e.g., M_{DE}RB 5)	
Cleanliness	Category (e.g., B)	
Volume stability	Category (e.g. MS_{RB} 6)	
Magnesium sulfate soundness		
Emission of radioactivity		
Release of heavy metals		
Release of polyaromatic carbons		
Relase of other dangerous substances		
Durability against freeze-thaw	Category (e.g. $F_{RB}2$ or F_{EC}RB 4*)*	
Durability against weathering	Category (e.g. SB_{RB} 1/8)	
Electrical conductivity	Declared (EC)	

Figure ZA.1— Example of CE marking information for aggregates for railway ballast under system 2+

CE	*CE conformity marking, consisting of the "CE"-symbol given in directive 93/68/EEC.*
Any Co Ltd, PO Box 21, B-1050	*Name or identifying mark and registered address of the producer*
13	*Last two digits of the year in which the marking was affixed*
0123-CPD-0456	*Number of the EC certificate*
EN 13450:2013 **Aggregates for railway ballast**	*No. of European Standard* *Description of product* *and* *information on product and on regulated characteristics*
Particle shape	Category (e.g. FI_{RB15})
Particle size	Designation (*d & D*) & Category (e.g., B)
Particle length	Category (PL..)
Particle density	Declared value (Mg/m^3)
Resistance to fragmentation / crushing	Category (e.g., $LA_{RB}18$) Category (e.g . SZ_{RB} 18)
Resistance to attrition	Category (e.g., M_{DE}RB 5)
Cleanliness	Category (e.g., B)
Volume stability	Category (e.g. MS_{RB} 6)
Magnesium sulfate soundness	
Emission of radioactivity	
Release of heavy metals	
Release of polyaromatic carbons	
Release of other dangerous substances	
Durability against freeze-thaw	Category (e.g. $F_{RB}2$ or F_{EC}RB 4*)*
Durability against weathering	Category (e.g. SB_{RB} 1/8)
Electrical conductivity	Declared (EC)

Figure ZA.2— Example of CE marking information for aggregates for railway ballast under system 4

Bibliography

EN 932-2, *Tests for general properties of aggregates — Part 2: Methods for reducing laboratory samples*

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

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