



SLOVENSKI STANDARD

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Preskusi mehanskih in fizikalnih lastnosti agregatov - 1. del: Določevanje odpornosti proti obrabi (mikro Deval)

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

Prüfverfahren für mechanische und physikalische Eigenschaften von Gesteinskörnungen - Teil 1: Bestimmung des Widerstandes gegen Verschleiß (Micro-Deval)

Essais pour déterminer les caractéristiques mécaniques et physiques des granulats —
Partie 1 : détermination de la résistance à l'usure (micro-Deval)

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NORME EUROPÉENNE
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Tests for mechanical and physical properties of aggregates - Part 1: Determination of the resistance to wear (micro-Deval)

Essais pour déterminer les caractéristiques
mécaniques et physiques des granulats - Partie 1 :
détermination de la résistance à l'usure (micro-Deval)

Prüfverfahren für mechanische und physikalische
Eigenschaften von Gesteinskörnungen - Teil 1:
Bestimmung des Widerstandes gegen Verschleiß
(Micro-Deval)

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 154.

If this draft becomes a European Standard, CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

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prEN 1097-1:2021 (E)**European foreword**

This document (prEN 1097-1:2021) has been prepared by Technical Committee CEN/TC 154 "Aggregates", the secretariat of which is held by BSI.

This document is currently submitted to the CEN Enquiry.

This document will supersede EN 1097-1:2011.

In comparison with the previous edition, the following technical modifications have been made:

- a) The European foreword, the Scope, the Terms and definitions and the Test report content have been updated according to the current rules;
- b) Normative references has been extended with EN 933-2;
- c) The definition of M_{DE} or $M_{DE,RB}$ has been added in Clause 3;
- d) The description of the micro-Deval apparatus has been clarified in Clause 5. Two optional apparatus, a gauge and a magnet, have been added;
- e) In the test procedure, amount of water is expressed in mass instead of volume. Subsequently, EN ISO 4788 *Laboratory glassware* has been deleted from Clause 2. Graduated glass cylinder has been deleted from Clause 5 Apparatus, and B.2 Apparatus has been deleted;
- f) Annex A has been completed to contain full text, not only the clauses expressing additions or modifications to main text clauses. Formula (A.1) has been changed;
- g) New informative Annexes D and E have been added and specify methods for determination of the wear of fine aggregates.

In addition, the Principle and Annex C have been simplified and the Bibliography has been supplemented.

This document forms part of a series of tests for mechanical and physical properties of aggregates. Test methods for other properties of aggregates are covered by the following European Standards:

- EN 932 (all parts), *Tests for general properties of aggregates*
- EN 933 (all parts), *Tests for geometrical properties of aggregates*
- EN 1367 (all parts), *Tests for thermal and weathering properties of aggregates*
- EN 1744 (all parts), *Tests for chemical properties of aggregates*
- EN 13179 (all parts), *Tests for filler aggregate used in bituminous mixtures*

The other parts of EN 1097 include:

- *Part 2: Methods for the determination of resistance to fragmentation*
- *Part 3: Determination of loose bulk density and voids*
- *Part 4: Determination of the voids of dry compacted filler*

- *Part 5: Determination of the water content by drying in a ventilated oven*
- *Part 6: Determination of particle density and water absorption*
- *Part 7: Determination of the particle density of filler — Pyknometer method*
- *Part 8: Determination of the polished stone value*
- *Part 9: Determination of the resistance to wear by abrasion from studded tyres — Nordic test*
- *Part 10: Determination of water suction height*

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prEN 1097-1:2021 (E)**1 Scope**

This document specifies the reference method used for type testing and in case of dispute, for determining the resistance to wear of coarse aggregates (main text) and aggregates for railway ballast (Annex A). Other methods can be used for other purposes, such as factory production control, provided that an appropriate working relationship with the relevant reference method has been established.

This document applies to natural, manufactured or recycled aggregates.

The reference test is performed with the addition of water. Annex B gives details of how the test can be performed without the addition of water.

Annex C specifies the test performed with alternative narrow size fractions.

Annexes D and E specify methods for determining the wear of fine aggregates.

Precision data are given in Annex F.

Annex A is normative and Annexes B, C, D, E and F are informative.

WARNING – The use of this part of EN 1097 can involve hazardous materials, operations and equipment (such as dust, noise and heavy lifts). It does not purport to address all of the safety or environmental problems associated with its use. It is the responsibility of users of this document to take appropriate measures to ensure the safety and health of personnel and the environment prior to application of this document, and fulfil statutory and regulatory requirements for this purpose.

2 Normative references

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The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 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*

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

EN 933-2, *Tests for geometrical properties of aggregates - Part 2: Determination of particle size distribution - Test sieves, nominal size of apertures*

ISO 3290-1, *Rolling bearings — Balls — Part 1: Steel balls*

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp/ui>

3.1

test portion

d_0/D_0

sample used as a whole in a single test

3.2

test specimen

sample used in a single determination when a test method requires more than one determination of a property

3.3

laboratory sample

sample intended for laboratory testing

3.4

constant mass

mass determined by successive weighings performed at least 1 h apart and not differing by more than 0,1 %

Note 1 to entry: In many cases constant mass can be achieved after a test portion has been dried for a pre-determined period in a specified oven at $(110 \pm 5)^\circ\text{C}$. Test laboratories can determine the time required to achieve constant mass for specific types and sizes of sample dependent upon the drying capacity of the oven used.

3.5

micro-Deval coefficient

M_{DE} or $M_{DE,RB}$

coefficient expressing the wear after completion of the test as the percentage of the test portion mass passing the 1,6 mm sieve

4 Principle

A test sample of a single-sized aggregate, 10 mm to 14 mm, is rotated together with steel balls and water in a steel drum. The contents roll within the drum with an abrading action. After the specified number of revolutions, the contents are removed from the drum and the aggregate portion is sieved on the 1,6 mm sieve.

The micro-Deval coefficient expresses the wear as the percentage by mass passing the 1,6 mm sieve.

NOTE A lower value of the micro-Deval coefficient indicates a better resistance to wear.

5 Apparatus

Unless otherwise stated, all apparatus shall conform to the general requirements of EN 932-5.

5.1 General apparatus

5.1.1 Equipment for reducing laboratory samples, as specified in EN 932-2.

5.1.2 Balance, capable of weighing both the test specimen and the charge to an accuracy of 0,1 % of the mass of the test specimen.

5.1.3 Test sieves, 1,6 mm, 8 mm, 10 mm, 11,2 mm (or 12,5 mm) and 14 mm, which shall conform to EN 933-2.

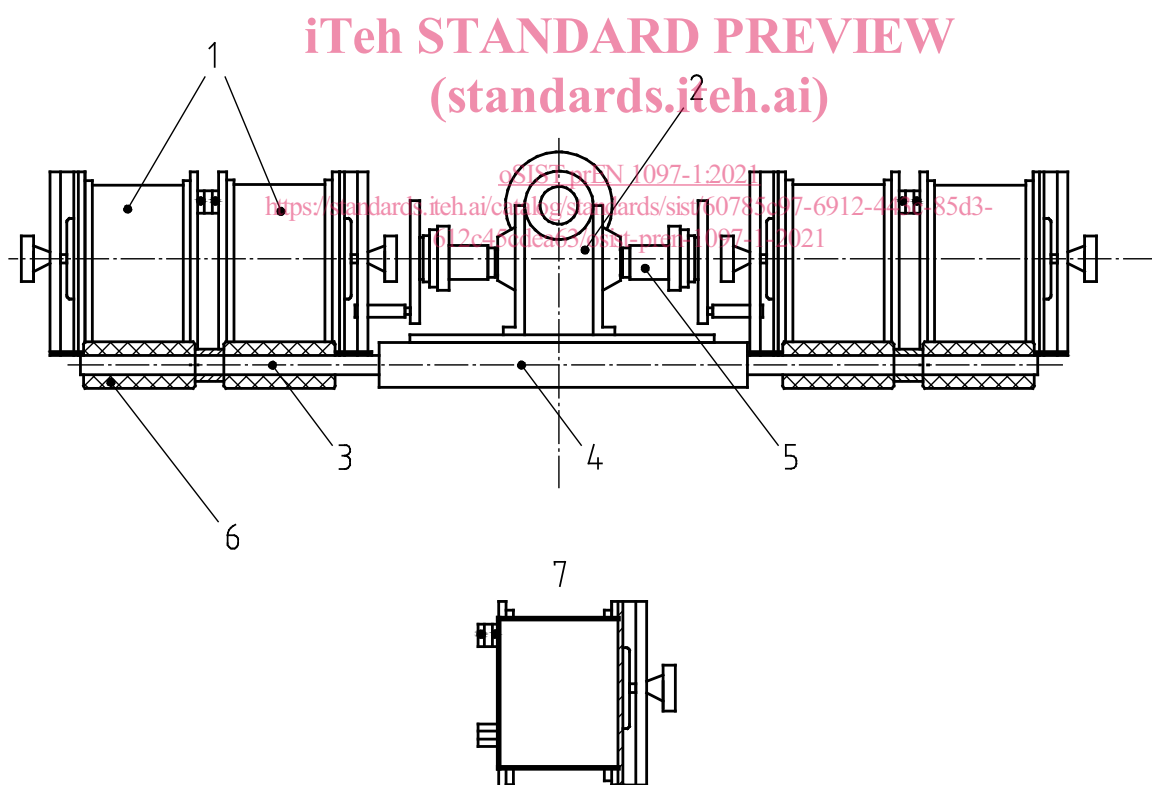
5.1.4 Ventilated oven, controlled to maintain a temperature of $(110 \pm 5) ^\circ\text{C}$.

5.1.5 Washing equipment.

5.2 Additional apparatus required for the determination of the micro-Deval coefficient

5.2.1 Micro-Deval apparatus, comprising the following essential parts.

NOTE An example of an apparatus that has been found to be satisfactory is shown in Figure 1.



Key

- | | | | |
|---|--------------------------------------|---|-------------------------|
| 1 | drums | 5 | flexible coupling |
| 2 | electric motor and reduction gearing | 6 | drive wheel |
| 3 | fixed shaft | 7 | cross section of a drum |
| 4 | frame | | |

Figure 1 — Typical micro-Deval apparatus

5.2.1.1 Hollow drums, made of stainless steel at least 3 mm thick and closed at one end. They shall be closed by flat lids at least 8 mm thick and fitted with watertight and dust tight seals.

The drums shall have an internal diameter of (200 ± 1) mm and an internal length measured from the base to the inside of the lid of (154 ± 1) mm. The inner surface of the drums shall be free of protrusions resulting from welding or the method of attachment.

The drums shall be placed on two fixed shafts which rotate about a horizontal axis.

5.2.1.2 Abrasive charge, consisting of steel balls complying with ISO 3290-1 ($10,0 \pm 0,5$) mm in diameter.

NOTE 1 The lower limit of deviation is a working tolerance limit.

NOTE 2 The diameter of the balls can be checked quickly by passing them over parallel bars 9,5 mm apart.

NOTE 3 A hardness of the steel balls between HRC 52 and HRC 67 is suitable.

5.2.1.3 Motor, imparting a rotational speed to the drums of (100 ± 5) r/min.

NOTE A motor capacity of about 1 kW is suitable.

5.2.1.4 Revolution counter, which will automatically stop the motor after the specified number of revolutions.

5.2.2 Gauge (optional), to control minimum ball size, fitted with slots $9,5 \pm 0,5$ mm.

5.2.3 Magnet (optional), for removal of the steel balls from the aggregate test specimen after abrasion.

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6 Preparation of test portion

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The test portion shall consist of two test specimens, each having a mass of (500 ± 3) g.

NOTE 1 A test specimen of normal weight aggregates comprises about 250 particles.

NOTE 2 Alternative size fractions for certain end uses are specified in Annex C. Testing other size fractions can produce results different from those obtained using the 10/14 mm size fraction.

The test shall be carried out on aggregate passing the 14 mm sieve and retained on the 10 mm sieve. In addition, the grading of the test portion shall comply with at least one of the following requirements:

- a) between 30 % and 40 % passing a 11,2 mm sieve; or
- b) between 60 % and 70 % passing a 12,5 mm sieve.

Sieve the laboratory sample using the 10 mm, 11,2 mm (or 12,5 mm) and 14 mm sieves to give separate fractions in the range 10 mm to 11,2 mm (or 12,5 mm) and 11,2 mm (or 12,5 mm) to 14 mm.

Wash each fraction on the sieve defining the lower limit of the size fraction. Dry the fractions to constant mass at (110 ± 5) °C.

Allow the fractions to cool to ambient temperature. Mix the two fractions to provide a modified 10 mm to 14 mm laboratory sample which complies with the appropriate additional grading requirements given in paragraph 2 of this clause.

Reduce the modified laboratory sample prepared from the mixed fractions to test portion size in accordance with EN 932-2.