SLOVENSKI STANDARD
SIST EN 1097-1:1999

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Preskusi mehanskih in fizikalnih lastnosti agregatov - 1. del: Določ evanje 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 a l'usure (micro-Deval)

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This European Standard was approved by CEN on 1996-07-12. CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

The European Standards exist in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CEN

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

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Contents

Foreword

This European Standard 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of an identical text or by endorsement, at the latest by January 1997, and conflicting national standards shall be withdrawn at the latest by January 1997.

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

EN 932	Tests for general properties of aggregates
EN 933	Tests for geometrical properties of aggregates
EN 1367	Tests for thermal and weathering properties of aggregates
EN 1744	Tests for chemical properties of aggregates

The other parts of EN 1097 will be:

Part 2	Methods for the determination of resistance to fragmentation
Part 3	Determination of loose bulk density and voids
Part 4	Determination of void in a dry compacted filler
Part 5	Determination of 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	Method for the determination of the resistance to wear by abrasion from studded tyres: Nordic test
Part 10	Water suction height

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

1 Scope

This European Standard specifies a procedure for measuring the resistance to wear of a sample of aggregate. The sample is normally tested in a wet condition but the test may also be carried out in a dry condition. This European Standard applies to natural or artificial aggregates used in building or civil engineering.

2 Normative references

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

prEN 932-2	Tests for general properties of aggregates. Part 2: Methods for reducing laboratory samples to test portions
prEN 932-5	Tests for general properties of aggregates Part 5 : Common equipment and calibration
prEN 933-1:1992	Tests for geometrical properties of aggregates Part 1: Determination of particle size distribution - Sieving method
ISO 3290:1975	Rolling bearings - Bearing parts - Balls for rolling bearings
ISO 4788:1980	Laboratory glassware - Graduated measuring cylinders
ISO 5725:1986	Precision of test methods - Determination of repeatability and reproducibility for a standard test method by inter-laboratory tests.

3 Definitions

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

3.1 test portion: The sample used as a whole in a single test.

3.2 test specimen: When a test method requires more than one determination of a property, the test specimen is the sample used in a single determination.

3.3 laboratory sample: A reduced sample derived from a bulk sample for laboratory testing.

3.4 constant mass: Successive weighings after drying at least 1 h apart not differing by more than 0,1 %.

NOTE: 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 ± 5) °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.

4 Principle

The test determines the micro-Deval coefficient which is the percentage of the original sample reduced to a size smaller than 1,6 mm during rolling.

The test consists of measuring the wear produced by friction between the aggregates and an abrasive charge in a rotating drum under defined conditions.

When rolling is complete, the percentage retained on a 1,6 mm sieve is used to calculate the micro-Deval coefficient.

The test method described in this European Standard is the reference method and is carried out with dry aggregate with the addition of water to give a value of M_{DE}. Annex A gives details of how the test can be performed without the addition of water, to give a value of M_{DS}.

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 prEN 932-5.

5.1 Standard apparatus

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

5.1.2 Set of sieves: 1,6 mm, 8 mm, 10 mm, 11,2 mm (or 12,5 mm) and 14 mm.

5.1.3 Ventilated oven, controlled to maintain a temperature of (110 ± 5) °C.

5.1.4 Means of washing the sieved sample.

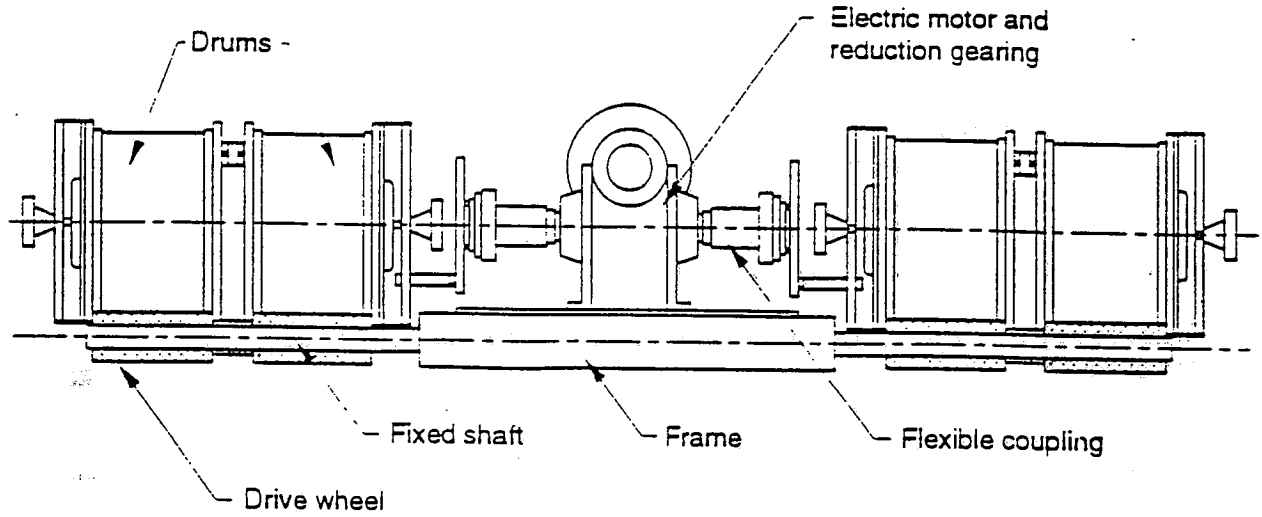
5.1.5 Equipment for reducing the laboratory samples to a test portion, as described in prEN 932-2.

5.1.6 Graduated glass measuring cylinder (or cylinders), conforming to ISO 4788:1980, or other means of measuring (2,5 ± 0,05) l of water.

5.2 Special apparatus

A typical micro-Deval apparatus as shown in figure 1. A micro-Deval apparatus shall have the following essential characteristics as specified in **5.2.1, 5.2.2, 5.2.3, 5.2.4** and **5.2.5**.

5.2.1 It shall consist of one to four hollow drums, closed at one end, having an inside diameter of (200 ± 1) mm and an internal length measured from the base to the inside of the lid of (154 ± 1) mm. The drums shall be made of stainless steel at least 3 mm thick which are placed on two shafts which rotate on a horizontal axis.



Cross section of a drum

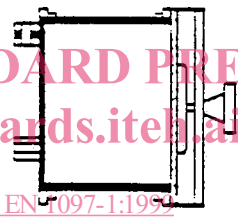


Figure 1: Diagram of typical apparatus

5.2.2 The insides of drums shall be free of protrusions resulting from welding or the method of attachment. The drums shall be closed by flat lids at least 8 mm thick and fitted with watertight and dust tight seals.

5.2.3 The abrasive charge shall consist of steel balls complying with ISO 3290:1975 (10 ± 0,5) mm in diameter.

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

5.2.4 A suitable motor (a capacity of about 1 kW is typical) to drive the drums at a regular speed of rotation of (100 ± 5) r/min.

5.2.5 A counter or other device shall be fitted, which automatically stops the motor after the specified number of revolutions.

6 Preparation of sample for testing

The mass of the sample sent to the laboratory shall have at least 2 kg of particles in the 10 mm to 14 mm size range.

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 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 separately, in accordance with 7.1 of prEN 933-1:1992, and dry them in the oven at (110 ± 5) °C to constant mass.

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 the requirements of prEN 932-2. The test portion shall consist of two test specimens, each having a mass of (500 ± 2) g.

7 Test procedure

Place each test specimen into a separate drum. Add sufficient steel balls to each drum to give a charge of (5000 ± 5) g.

Add (2,5 ± 0,05) l of water to each drum.

Fit a lid to each drum, and place each drum on the two shafts.

Rotate the drums at a speed of (100 ± 5) min^{-1} for (12 000 ± 10) revolutions.

After the test, collect the aggregate and the steel balls in a pan, taking care to avoid the loss of any aggregate. Using a washing bottle, carefully wash the inside of the drum and the lid, and retain the washings.

Empty the material and all the washings on to the 1,6 mm sieve protected by an 8 mm guard sieve. Wash the materials in a stream of clean water.

Carefully separate the aggregate particles retained on the 8 mm guard sieve from the steel balls, taking care not to lose any aggregate particles. The aggregate particles may be picked out by hand, or the balls may be removed from the sieve using a magnet.

Place the aggregate particles retained on the 8 mm guard sieve onto a tray. Add the material retained on the 1,6 mm sieve to the same tray.

Dry the tray and its contents in the oven at (110 ± 5) °C. Complete the determination of the mass retained on the 1,6 mm sieve in accordance with prEN 933-1.

Record the mass (m) retained on the 1,6 mm sieve to the nearest gram.