



BSI Standards Publication

Concrete pavements

Part 4: Test methods for the determination of wear resistance of concrete pavements to studded tyres

National foreword

This British Standard is the UK implementation of EN 13863-4:2012. It supersedes BS EN 13863-4:2004 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee B/510/3, Materials for concrete roads.

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

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English Version

Concrete pavements - Part 4: Test methods for the determination of wear resistance of concrete pavements to studded tyres

Revêtements en béton - Partie 4: Méthodes d'essai pour la détermination de la résistance à l'usure par abrasion provoquée par les pneus à crampons des revêtements en béton

Fahrbahnbefestigungen aus Beton - Teil 4: Prüfverfahren zur Bestimmung des Widerstandes gegen Verschleiß durch Spikereifen von Fahrbahnbefestigungen aus Beton

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Foreword

This document (EN 13863-4:2012) has been prepared by Technical Committee CEN/TC 227 “Road materials”, the secretariat of which is held by DIN.

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of an identical text or by endorsement, at the latest by October 2012, and conflicting national standards shall be withdrawn at the latest by October 2012.

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 13863-4:2004.

In comparison with the previous version of the Standard published in 2004, the configuration of the test equipment is now more precisely described.

This European Standard is one of a series concerned with test methods for the functional requirements for concrete pavements:

- EN 13863-1, *Concrete pavements — Part 1: Test method for the determination of the thickness of a concrete pavement by survey method*;
- EN 13863-2, *Concrete pavements — Part 2: Test method for the determination of the bond between two layers*;
- EN 13863-3, *Concrete pavements — Part 3: Test methods for the determination of the thickness of a concrete pavement from cores*;
- EN 13863-4, *Concrete pavements — Part 4: Test methods for the determination of wear resistance of concrete pavements to studded tyres*.

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, 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 describes a test method for the determination of the wear resistance to studded tyres of specimens either cut from hardened concrete pavements or moulded in laboratory.

NOTE The test method is applicable for the finished concrete (end product testing) and not only for the aggregate as described in EN 1097-9. In the report from Swedish Road and Transport Research Institute (1996), *Ring Analysis of Nordic Road Simulators: Proposal for a common test method for the determination of the wear resistance of concrete pavements*, more information of the methods precision is given (see Bibliography).

Three different configurations of the test equipment are considered in this document, one using truck-wheels and the other two using car-wheels.

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

EN 197-1, *Cement — Part 1: Composition, specifications and conformity criteria of common cements*

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

EN 12504-1, *Testing concrete in structures — Part 1: Cored specimens — Testing, examining and testing in compression*

3 Test specimen

The sample shall consist of at least two specimens. Specimens shall conform to the dimensions in Table 1 according to road testing machines used.

Table 1 — Dimension of specimens

Method	Thickness mm	Width mm	Edge-length mm
Method 1 ^a Trapezoid specimens	250	900	$L_1 = 1\,340$ $L_2 = 1\,810$
Method 2 ^a Half trapezoid specimens	40	480	$L_1 = 580$ $L_2 = 680$
Method 3 ^a Segment	90	300	1 760 (middle line length)

^a See example of road testing machines in the paper referred to in Bibliography.

4 Test equipment

Measuring apparatus to determine depth of rut shall have an accuracy $\pm 0,1$ mm.

The test configuration for methods 1, 2 and 3 shall be in accordance with Tables 2, 3 and 4, respectively.

Table 2 — Test configuration for method 1

Specification	Value
Diameter of testing machine	6 m
Wheel load	2,5 t
Contact pressure	0,7 MPa
Speed	60 km/h
Four truck-wheels with studs	400 pieces, 12/17 g, on each wheel
Air-temperature in room	+10 °C to +25 °C

Table 3 — Test configuration for method 2

Specification	Value
Diameter of testing machine	5,25 m
Wheel load	0,45 t
Contact pressure	0,2 MPa
Speed	85 km/h
Four car-wheels with studs 185/70 R14	110 pieces, 1,8 g, on each wheel
Air-temperature in room	±0 °C to +10 °C

Table 4 — Test configuration for method 3

Specification	Value
Diameter of testing machine	3,36 m
Wheel load	0,40 t
Contact pressure	0,22 MPa
Speed	31 km/h
Four car-wheels with studs 165/82 R13	90 pieces, 1,8 g kometa P8-110/1,8, or similar, on each wheel
Air-temperature in room	±0 °C to +10 °C

Two reference segments shall always be used in every wear test. The segments shall conform to the specifications in Table 5.

Table 5 — Material specification of the reference segment

Binder	Cement	390,0 kg/m ³
Binder	Silica fume	15,0 kg/m ³
Sand	0 mm to 4 mm	797,5 kg/m ³
Crushed aggregate	8 mm to 12 mm	582,0 kg/m ³
Crushed aggregate	12 mm to 16 mm	582,0 kg/m ³
Water to (cement + silica)		0,40
Slump		20 mm to 60 mm
Material < 4 mm		32 % to 25 %
Fineness modulus FM		~ 5,5
Compressive strength		(85 ± 2) MN/m ²

Sand shall be of an uncrushed type.

Crushed aggregate shall have a Nordic abrasion value between 7 and 8 (for sieve 12 mm to 16 mm) in accordance with EN 1097-9.

Cement shall be of type CEM I – 52,5 LA in accordance with EN 197-1, the Blaine value shall be between 3 400 cm²/g to 3 800 cm²/g in accordance with EN 196-6.

Compressive strength value shall be based on EN 12504-1.

Aggregate shall have an even grading curve.

5 Preparation of samples

Elements taken from the concrete pavements shall have an age corresponding to (10 ± 2) weeks at a temperature of + 20 °C when testing, or as specified in place of use. Elements shall be stored in the same way as for moulded specimens.

The surface shall be trowelled.

Moulded specimens shall first be moist cured for 2 days, remaining curing time of moulded specimens shall be at (+ 20 ± 2) °C, (50 ± 10) % RH.

Moulded specimens shall be (10 ± 2) weeks old when testing.

6 Procedure

Install the concrete elements in the road testing-machine (methods 1, 2 or 3), and perform a zero drive. The road testing-machine shall be driven in 1 000 revolutions and the zero measurement taken.

Testing sequence shall be carried out in accordance with Table 6 (methods 1 and 2) and Table 7 (method 3).

Table 6 — Testing sequence for methods 1 and 2

Testing sequence	Type of wear	Method 1	Method 2
1. Number of revolutions	dry	10 000 ^a	30 000 ^a
2. Number of revolutions	dry	10 000	30 000
3. Number of revolutions	wet	10 000	30 000
4. Number of revolutions	dry	10 000	30 000
5. Number of revolutions	wet	10 000	30 000
6. Number of revolutions	dry	10 000	30 000
7. Number of revolutions	wet	10 000	30 000
Total		70 000	210 000
^a Initial wear.			

Table 7 — Testing sequence for method 3

Testing sequence	Type of wear	Method 3
1. Number of revolutions	wet	30 000 ^a
2. Number of revolutions	wet	30 000
3. Number of revolutions	dry	60 000
4. Number of revolutions	wet	120 000
5. Number of revolutions	dry	120 000
6. Number of revolutions	wet	180 000
7. Number of revolutions	dry	180 000
Total		750 000
^a Initial wear.		

The depth of wear shall be measured for each testing sequence. The wear profile shall be measured at least in eight points across the wear track.

The result from the test shall be presented in Relative Wear Index (*RWI*). The Relative Wear Index shall be calculated accordingly to Formula (1).

$$RWI = \frac{S}{S_r} \times 100 \quad (1)$$

where

RWI is the Relative Wear Index;

S is the total wear of testing specimens (with initial wear), in millimetres (mm);

S_r is the total wear of reference specimens (with initial wear), in millimetres (mm).

The *RWI* value shall be expressed as a whole number. Initial wear shall be presented in mm. Initial wear shall be measured after the first testing sequence.

For method 1 and method 2, calculate SPS_v in accordance with Formula (2).

$$SPS_v = (0,8 S_t + 0,2 S_v) \times K_w \quad (2)$$

where

- SPS_v is the relative concrete wear in relation to reference segment;
- S_t is the total dry wear (without initial wear), in millimetres (mm);
- S_v is the total wet wear (without initial wear), in millimetres (mm);
- K_w is the wheel constant according to reference segment (without initial wear).

$$K_w = \frac{9}{(0,8 \times S_{t,ref} + 0,2 \times S_{v,ref})} \text{ (without initial wear)} \quad (3)$$

where

- $S_{t,ref}$ is the total dry wear (without initial wear) for reference segment, in millimetres (mm);
- $S_{v,ref}$ is the total wet wear (without initial wear) for reference segment, in millimetres (mm).

7 Report

The test report shall include at least the following information:

- a) reference to this document;
- b) name and address of the testing laboratory;
- c) date and identification symbols of the report;
- d) test method used (number);
- e) name and address of the person or institution who ordered the test;
- f) name of the person performing the test;
- g) name and address of the manufacturer of the concrete;
- h) identification symbols, composition and age;
- i) date when the test was performed;
- j) test results in RWI , and the SPS_v value for methods 1 and 2 shall also be submitted;
- k) initial wear in millimetre (mm);
- l) the result in the form of diagram with mean value of wear, in millimetres (mm), on the vertical axis and revolutions on the horizontal axis. Wear result after each testing sequence shall be presented;
- m) any deviation from this document.

Bibliography

- [1] Swedish Road and Transport Research Institute, *Ring Analysis of Nordic Road Simulators: Proposal for a common test method for the determination of the wear resistance of concrete pavements*, no 774A-1996, Linköping Sweden, ISSN 0347-6049.

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