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ISO 10844

Second edition
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Acoustics — Specification of test tracks for measuring noise emitted by road vehicles and their tyres

Acoustique — Spécification des surfaces d'essai pour le mesurage du bruit émis par les véhicules routiers et leurs pneumatiques

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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

ISO 10844 was prepared by Technical Committee ISO/TC 43, *Acoustics*, Subcommittee SC 1, *Noise*, in cooperation with ISO/TC 22, *Road vehicles*.

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This second edition cancels and replaces the first edition (ISO 10844:1994), of which it constitutes a technical revision.

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Introduction

In general, the road surface parameters affecting the noise emission of vehicles are the texture and sound absorption characteristics. In addition, the mechanical impedance and the skid resistance properties of the surface layer may also influence measured noise levels.

In order to minimize the variation in rolling sound emission and vehicle sound emission measurements made at different testing locations it is, therefore, necessary to specify the relevant surface properties and recommend carefully the properties of the materials, design, construction of the test surface.

The principal objective of this International Standard is to provide a revised specification of the surface which improves the reproducibility of measurement.

This International Standard is designed in a way that test tracks conforming to this International Standard are compatible with ISO 10844:1994, but in addition the variability of properties is reduced.

It is important that the test provides a high degree of reproducibility between different test sites and that the surface design should not only minimize the inter-site variation of tyre/road noise, but should also ensure that the propagation of noise is unaffected by the surface used. This latter consideration precludes the use of road surfaces which have open textures and which have the property of absorbing noise from the power unit and other related sources.

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This International Standard is a revised version of ISO 10844:1994, including more restrictive specifications of the surface and recommendations for the test track construction process and maintenance. The basic properties of the surface remain unchanged.

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The users of this International Standard are encouraged to measure END_T and to communicate the data to the ISO/TC 43/SC 1/WG 42 for analysis before the next periodical review.

Furthermore, this International Standard recommends a non destructive test method for periodical checking of the surface characteristics.

ISO 10844 is quoted in several International Standards (e.g. ISO 362, ISO 13325).

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Acoustics — Specification of test tracks for measuring noise emitted by road vehicles and their tyres

1 Scope

This International Standard specifies the essential characteristics of a test surface intended to be used for measuring vehicle and tyre/road noise emissions.

The surface design given in this International Standard:

— produces consistent levels of tyre/road sound emission under a wide range of operating conditions including those appropriate to vehicle sound testing;

— minimizes inter-site variation;

— provides minor absorption of the vehicle sound sources;

— is consistent with road-building practice.

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NOTE For the purposes of this International Standard, the terms noise and sound are used interchangeably.

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2 Normative references

The following referenced documents are indispensable for the application 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.

ISO 362-1, *Measurement of noise emitted by accelerating road vehicles — Engineering method — Part 1: M and N categories*

ISO 13472-2, *Acoustics — Measurement of sound absorption properties of road surfaces* in situ *— Part 2: Spot method for reflective surfaces*

ISO 13473-1, *Characterization of pavement texture by use of surface profiles — Part 1: Determination of Mean Profile Depth*

ISO 13473-3, *Characterization of pavement texture by use of surface profiles — Part 3: Specification and classification of profilometers*

ISO/TS 13473-4, *Characterization of pavement texture by use of surface profiles — Part 4: Spectral analysis of surface profiles*

EN 13036-7, *Road and airfield surface characteristics — Test methods — Part 7: Irregularity measurement of pavement courses: the straightedge test*

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3 Terms and definitions

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

3.1
sound absorption coefficient
α
fraction of the sound power incident on the test object that is absorbed within the test object for a plane wave at normal incidence

NOTE Expressed as a percentage it is called sound absorption.

3.2
surface profile

3.2.1
texture profile
two-dimensional sample of pavement texture generated if a sensor, such as the tip of a needle or a laser spot, continuously touches or shines on the pavement surface while it is moved along a line on the surface

NOTE It is described by two coordinates: one along the surface plane, called “distance” (the abscissa), and the other in a direction normal to the surface plane, called “amplitude” (the ordinate).

3.2.2
irregularity
maximum distance of a surface from the measurement edge of the straightedge between two contact points of the straightedge when placed perpendicular to the surface

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NOTE 1 Pavement characteristics at longer wavelengths than 0,5 m are considered to be above that of texture and are referred to here as irregularity.

NOTE 2 Refer to Figure C.1.

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3.2.2.1
longitudinal irregularity
irregularity in the longitudinal axis of the track

3.2.2.2
transversal irregularity
irregularity in the direction perpendicular to the axis of the track

3.2.3
straightedge
device used for measuring the deviation from a plane

3.2.4
megatexture
deviation of a pavement surface from a true planar surface with the characteristic dimensions along the surface of 50 mm to 500 mm, corresponding to texture wavelengths with one-third-octave bands including the range 63 mm to 500 mm of centre wavelengths

NOTE Peak-to-peak amplitudes normally vary in the range 0,1 mm to 50 mm. This type of texture is the texture which has wavelengths in the same order of size as a tyre/road interface and is often created by potholes or “waviness”. It is usually an unwanted characteristic resulting from defects in the surface. Surface roughness with longer wavelengths than megatexture is referred to as irregularity.

3.2.5
macrotexture
deviation of a pavement surface from a true planar surface with the characteristic dimensions along the surface of 0,5 mm to 50 mm, corresponding to texture wavelengths with one-third-octave bands including the range 0,63 mm to 50 mm of centre wavelengths

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NOTE Peak-to-peak amplitudes may normally vary in the range 0,1 mm to 20 mm. This type of texture is the texture which has wavelengths of the same order of size as tyre tread elements in the tyre/road interface. Surfaces are normally designed with a sufficient macrotexture to obtain suitable water drainage in the tyre/road interface. The macrotexture is obtained by suitable proportioning of the aggregate and mortar of the mix or by surface finishing techniques.

3.2.6
microtexture
deviation of a pavement surface from a true planar surface with the characteristic dimension along the surface below 0,5 mm, corresponding to texture wavelengths with one-third-octave bands with centre wavelengths less than or equal to 0,50 mm

3.3
gradient and cross fall

3.3.1
gradient
ratio of the height difference and the length measured along the longitudinal axis of the drive lane, expressed as a percentage

3.3.2
cross fall
height difference expressed as a percentage of the length measured along the transversal axis of the drive lane

3.4
propagation area
part of the test track on each side of the drive lane (see Figure 1)

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3.5
drive lane
part of the test track where the vehicle runs

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3.6
stiffness
ratio of a normal force and resulting displacement

3.7
dense asphalt concrete
asphalt in which the aggregate particles are essentially continuously graded to form an interlocking structure

NOTE Definition from EN 13108-1.

3.8
mean profile depth
average value of the height difference between the profile and a horizontal line through the highest peak (the peak level) over a 100 mm long baseline

NOTE Adapted from ISO 13473-1:1997, 3.5.4.

4 Requirements of the test track

4.1 Size and geometry

4.1.1 Size

The test track shall consist of two areas, a drive lane and a propagation area. The dimensions shall comply with Figure 1 and Table 1.

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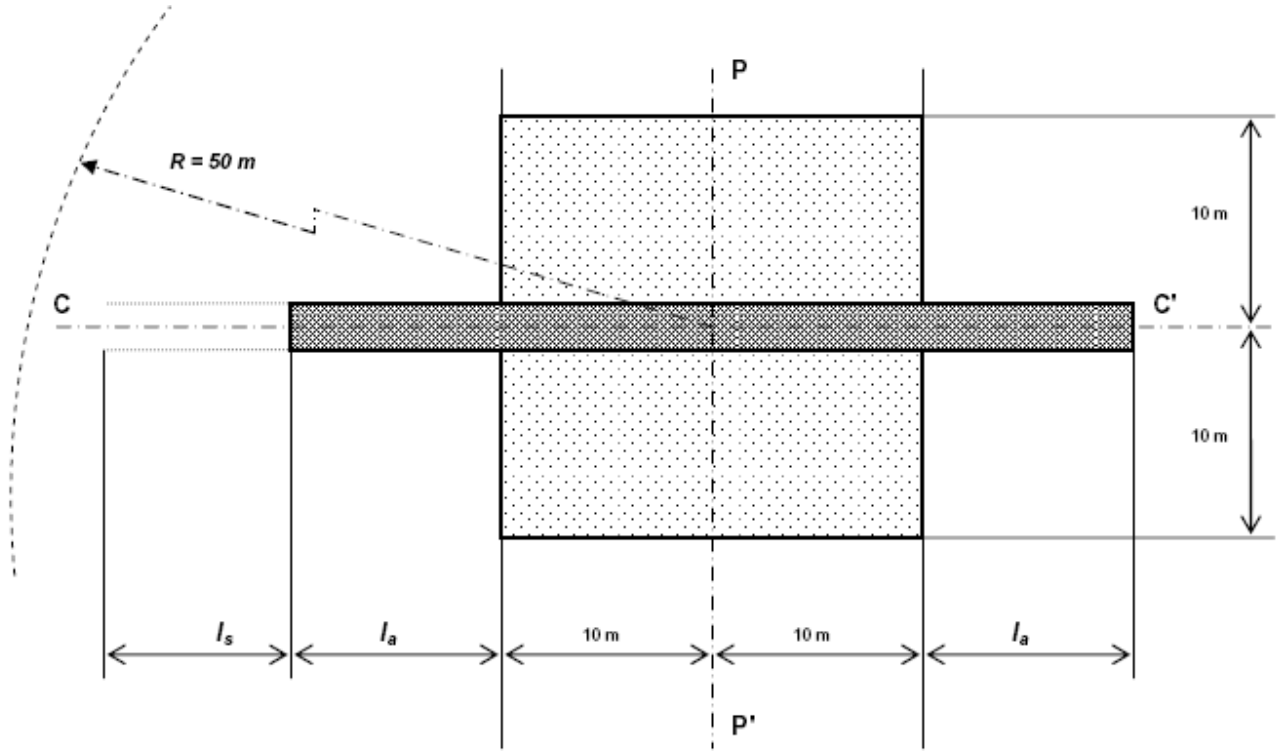

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Key

l_s	construction run-up section
l_a	drive lane extension beyond propagation area
CC'	drive lane centre line
PP'	microphone line
A	propagation area
dotted area	drive lane

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Figure 1 — Size of the test track

A drive lane with a length of l_a and width of at least 3,0 m that is centered around line PP'. The value of l_a is defined in Table 1.

Table 1 — Minimum drive lane extension length

Length	For testing tyres, passenger cars, motorcycles, light duty vehicles, trucks	For long vehicles with rear engine, having a distance of more than10 m between reference point and the front axle (reference point as defined in ISO 362-1)
l_a	10 m	20 m[a]
[a] 20 m is necessary only for the exit side (BB') as defined in ISO 362-1of the test track according to the purpose of this requirement		

NOTE For the stabilization of the laying process, a minimum length of l_s = 60 m is recommended on at least one side.

The propagation area shall extend at least 10 m from the centre of the drive lane and at least 10 m at both sides of the line PP'.

Within a radius of 50 m around the centre of the track the space shall be free of large reflecting objects such as fences, rocks, bridges or buildings.

NOTE Buildings outside the 50 m radius can have significant influence if their reflection focuses on the test track.

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4.1.2 Geometry

a) Drive lane

The drive lane shall fulfil the following requirements:

— For acceptance of the test track only, transverse irregularities equal to or less than 0,003 m and longitudinal irregularities equal to or less than 0,002 m measured with the straightedge according to EN 13036-7;

— For periodical checking of the test track only, transverse irregularities equal to or less than 0,005 m and longitudinal irregularities equal to or less than 0,005 m measured with the straightedge according to EN 13036-7;

— For acceptance only, deviation from the horizontal plane in transverse direction of 1,0 % maximum (see Figure 2) and in a longitudinal direction of 0,5 % maximum.

It is recommended that the irregularities requirements be fulfilled starting from the microphone line to cover the drive lane plus 10 m from the end of the section l_a on both sides.

b) Propagation area

— The propagation area shall have irregularities equal to or less than 0,02 m measured with the straightedge according to EN 13036-7;

— The propagation area may have one or both sides lower than the drive lane. Cross fall in transverse direction, measured using an appropriate instrument, shall be equal or less than 2,0 % (see Figure 2);

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NOTE The slope should be designed in such a way that the draining of water is possible.

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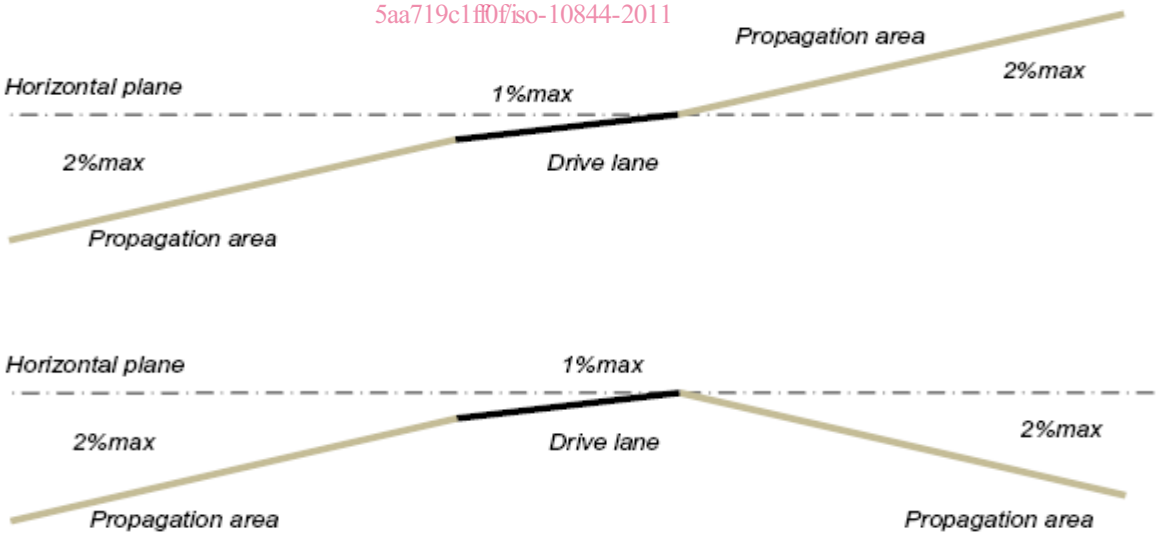

Figure 2 (*continued*)

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Key

1 % max: Allowed drive lane cross fall

2 % max: allowed propagation area cross fall

Figure 2 — Propagation area slope in transverse direction

— Steps or discontinuities between the propagation area and the drive lane shall be $0^{+0,02}_{0}$ m (see Figure 3).

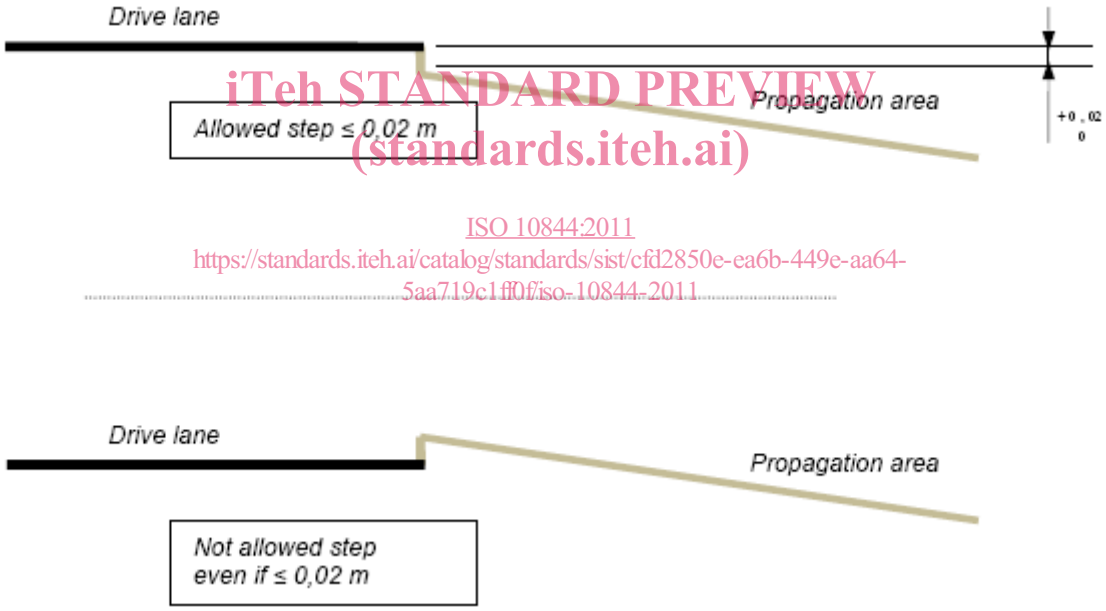

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Figure 3 — Propagation area – Steps or discontinuities

4.2 Surface properties of the propagation area

The average of the values of the sound absorption in each one-third-octave-band between 315 Hz and 1 600 Hz central frequency shall be less than or equal to 10 %. The sound absorption coefficient shall be measured according to 5.3.

Location and number of measurement points are given in 4.4.

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4.3 Surface properties of the drive lane

The surface of the drive lane shall:

a) be dense asphalt concrete,

b) exhibit a sound absorption equal to or less than 8 % in any one-third-octave band between 315 Hz and 1 600 Hz when measured according to 5.3,

c) have a maximum chipping size of 8 mm (tolerance allowed between 6,3 mm to 10 mm),

d) have a thickness of the wearing course greater or equal than 30 mm,

e) have a Mean Profile Depth measured according to ISO 13473-1 of 0,5 mm ± 0,2 mm,

f) have a target sieving curve for the aggregate as described in Figure 4.

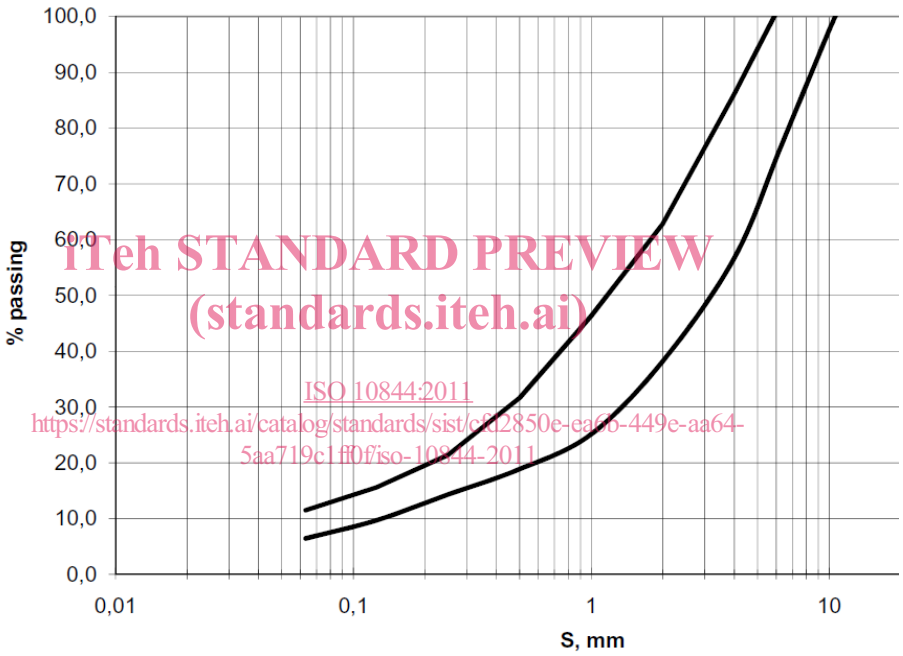

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Figure 4 — Sieving curve area

NOTE Until more results for validation are available, END_T is not part of the normative part of this International Standard. The present state of the art with respect to this method is described in Annex A but is restricted to cases where no elastic material (rubber, polyurethane, etc) is applied in the top layer or sub-layers except for modification of bitumen by less than 1 % by mass of the total mix. Polymer-modified bitumen allows higher termperature operation and reduced surface wear.

4.4 Conformity tests

a) The surface properties for each requirement shall be determined at the following occasions before the acceptance of the track (refer to Table 2);

b) During the periodical checking of the track (refer to Table 2);

c) All measurements shall be made along the total length of the drive lane in each wheel track according to the following scheme (see an example in Figure 5);

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d) For sound absorption, texture, geometrical compliance, the first point shall be chosen randomly on each side in the vicinity of the line PP' and the subsequent measurements shall be performed at 5 m intervals not on the same axis of the centre line to cover the whole track;

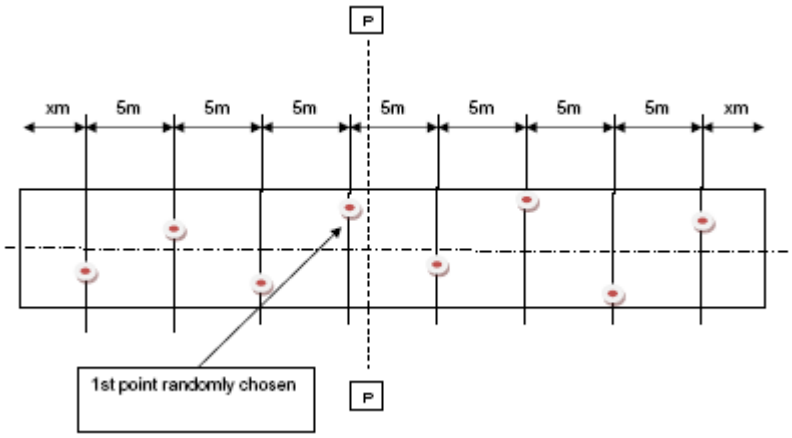

Figure 5 — Measurement positions on test track, example for l = 40 m

e) After construction take a total of four cores, preferably at 10 m intervals outside the wheel tracks on the driving lane run up section, and measure the sieving curve from these samples.

For checking the surface properties of the propagation area, take at least two measurements randomly chosen on each side.

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In addition, sound absorption of the propagation area shall be measured at both sides of the drive lane between the microphone location and the centre of drive lane in the vicinity of the line PP'.

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Table 2 — Periodicity for checking the requirements during acceptance and periodical checking

Requirements for the track		For acceptance		For periodical checking	
		Drive lane	Propagation area	Drive lane	Propagation area
Slope	Gradient	× (0,5 %)	N.A.	N.A.	N.A.
	Cross fall	× (1 %)	× (2 %)	N.A.	N.A.
Longitudinal irregularity		× (⩽2 mm)	× (⩽20 mm) randomly	× (⩽5 mm) 2 years[a]	N.A.
Transverse irregularity		× (⩽3 mm)		× (⩽5 mm) 2 years[a]	N.A.
Texture		× MPD 0,5 mm ± 0,2 mm	N.A.	× MPD 0,5 mm ± 0,2 mm 2 years[a]	N.A.
Absorption		× (8 % max)	× (10 %max)	× (8 % max) 4 years[a]	N.A.
Grading curve		×	N.A.	N.A.	N.A.

× to be checked
N.A. not applicable
[a] Periodicity.

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4.5 Homogeneity of surface properties

In order to ensure that the properties of the drive lane and the properties of the propagation area are homogeneous, the average of all positions and 80 % of the samples shall meet the requirements with respect to:

— acoustic absorption;

— surface texture;

— geometrical compliance.

4.6 Stability with time and maintenance

The test track is a test instrument and shall be protected from damage and be taken care of. The test track should be used only for noise measurements.

Loose debris or dust which could significantly reduce the texture depth shall be removed from the surface.

Sealing of cracks is acceptable as long as acoustical performances (as per 4.2 and 4.3) of the test track are not affected.

See Annex B for recommendations.

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4.7 Break-in of the test track

The texture and absorption characteristics shall be checked not earlier than 4 weeks after construction or 1 000 passes after construction.

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If the surface is exclusively used for testing heavy vehicles (M2 above 3,5 t, M3, N2 and N3) this break-in period is not necessary.

5 Measurement methods and data processing

5.1 Irregularity measurement methods

The irregularity of the drive lane shall be determined according to EN 13036-7 using a straightedge consisting of a beam of 3,0 m length and wedge with 1 mm steps on the oblique side.

5.2 Texture measurements methods

5.2.1 Profile measurement

The profile is measured according to ISO 13473-1 for MPD and ISO 13473-3 for END_T. The measurement instrumentation shall meet the requirements of class DE defined in ISO 13473-3.

Additional details to ISO 13473-1 — MPD shall be measured in the wheel tracks of the driving lane and the following two options may be used:

— Continuous measurement: MPD is measured continuously over the entire driving lane. The measured profile shall be divided into eight sections, each 5 m long, for which MPD shall be evaluated separately as average over the section. A total of two measurement runs shall be made in each wheel track,

— Segmented measurement: MPD is measured at a minimum of four locations in each of the two wheel tracks (eight if the test track is used for two-wheeled vehicles). These locations shall be evenly distributed over the driving lane length. At each such location, a minimum length of 2,0 m of profiles shall be

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