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Fourth edition
2021-12

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

Acoustique — Spécification des surfaces d'essai pour le mesurage du son 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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 43, *Acoustics*, Subcommittee SC 1, *Noise*.

This fourth edition cancels and replaces the third edition (ISO 10844:2014), which has been technically revised.

The main changes compared to the previous edition are as follows:

— various revisions to improve track reproducibility;

— reduce ambiguity in the document.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

In general, the road surface parameters affecting the sound emission of vehicles are the texture and sound absorption characteristics. In addition, the mechanical impedance and the skid resistance properties of the surface layer can influence measured sound 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, and construction of the test surface.

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

This document is designed in a way that test tracks conforming to this document are compatible with previous editions, 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 or road sound, but should also ensure that the propagation of sound 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 sound from the power unit and other related sources.

In relation to the previous editions, this document includes more restrictive specifications of the surface and recommendations for the test track construction process and maintenance. The basic properties of the surface remain unchanged.

Furthermore, this document recommends a non-destructive test method for periodic checking of the surface characteristics.

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

1 Scope

This document specifies the essential characteristics of a test track surface intended to be used for measuring rolling sound emission of vehicles and their tyres.

The surface design given in this document

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

— minimizes inter-site variation,

— limits absorption of the vehicle sound sources, and

— is consistent with road-building practice.

2 Normative references

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.

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*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 362-1, ISO 13473-1 and the following apply.

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

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
sound absorption
fraction of the sound power incident on the test object that is absorbed within the test object for a plane wave at normal incidence, expressed as a percentage

3.2 Surface profile

3.2.1
irregularity
maximum variation of a surface from the measurement edge of a straightedge of minimum 3 m, measured between two contact points of the straightedge when placed perpendicular to the surface

3.2.1.1
longitudinal irregularity
irregularity (3.2.1) in the direction parallel to the longitudinal axis of the track

3.2.1.2
transverse irregularity
irregularity (3.2.1) in the direction parallel to the transverse axis of the track

3.2.2
texture profile
surface profile of a cross-section through a pavement limited to the texture range

Note 1 to entry: The surface profile is as defined in ISO 13473-1.

3.3 Slope and step

3.3.1
gradient
ratio of the height difference to the length measured parallel to the longitudinal axis of the track

Note 1 to entry: The gradient is expressed as a percentage.

3.3.2
cross fall
ratio of the height difference to the length measured parallel to the transverse axis of the track

Note 1 to entry: The cross fall is expressed as a percentage.

3.3.3
step
height difference between the edge of the drive lane and the propagation area

3.4
propagation area
part of the test track on each side of the drive lane

Note 1 to entry: See Figure 1.

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

3.6
dense asphalt concrete
asphalt in which the aggregate particles are essentially continuously graded to form an interlocking structure

3.7
mean profile depth
average value of the *texture profile* (3.2.2) depth

Note 1 to entry: The mean profile depth is as defined in ISO 13473-1, expressed in millimetres.

3.8
heavy vehicle
vehicle category M2 above 3,5 t, M3, N2, and N3

Note 1 to entry: Vehicle categories are as defined in ISO 362-1.

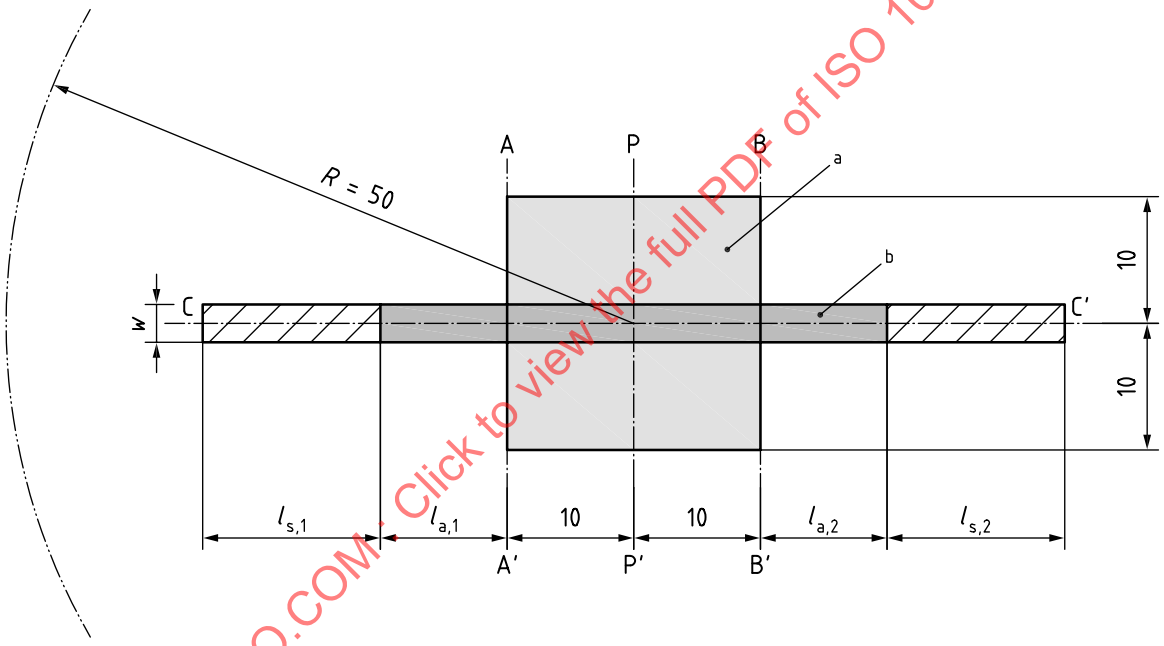
4 Requirements of the test track

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 of the drive lane and propagation areas to be tested in this standard shall comply with Figure 1 and Table 1.

Dimensions in metres



Key

$l_{s,1}$	entrance construction run-up section (diagonal hatch area), in metres
$l_{s,2}$	exit construction run-up section (diagonal hatch area), in metres (length of entrance and exit construction run-up sections can differ)
$l_{a,1}$	entrance drive lane extension beyond propagation area, in metres
$l_{a,2}$	exit drive lane extension beyond propagation area, in metres (length of entrance and exit drive lane extensions can differ)
w	drive lane width, in metres
AA'	entrance to propagation area 10 m before line PP'
BB'	exit from propagation area 10 m after line PP'
CC'	drive lane centre line (longitudinal axis)
PP'	microphone line (transverse axis)
a	Propagation area.
b	Drive lane.

Figure 1 — Size of the test track

The drive lane shall have a length of 20 m centred around line PP', plus drive lane extensions on both ends, each with a minimum length of l_a as defined in Table 1. The drive lane shall have a minimum width of 3,0 m. The drive lane is not necessarily constructed as a single paved lane. However, this practice is recommended.

Wheel tracks shall be designated based on the vehicles anticipated to use the track.

NOTE 1 The drive lane width is not necessarily the same as the paved lane width.

Table 1 — Minimum drive lane extension length

Length	For testing tyres, passenger cars, motorcycles, light duty vehicles, and trucks	For testing long vehicles with rear engine, having a distance of more than10 m between the 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 362-1, of the test track according to the purpose of this requirement.		

For the stabilization of the laying process, a minimum construction run-up section 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 (line CC') and at least 10 m to both sides of the line PP'.

Within a radius of 50 m around the intersection of CC' and PP', the space shall be free of large reflecting objects such as solid fences, bridges, or buildings. Objects suspected to be large reflecting may be evaluated using appropriate acoustical measurement methods.

NOTE 2 Buildings outside the 50 m radius can have significant influence if their reflection focuses on the test track.

4.1.2 Slope and step

Conformity for cross fall shall be evaluated separately for the drive lane and propagation area.

Principal requirements for conformity:

— cross fall arithmetically averaged over all measurement intervals shall be equal to or less than the requirement;

— at least 80 % of all measurement intervals shall have cross fall equal to or less than the requirement;

— gradient arithmetically averaged over all measurement intervals shall be equal to or less than the requirement;

— at least 80 % of all measurement intervals shall have gradient equal to or less than the requirement;

— absolute value of step arithmetically averaged over all measurement points shall not exceed the requirement;

— at least 80 % of all measurement points shall have step that does not exceed the requirement.

Requirements for acceptance of the track only:

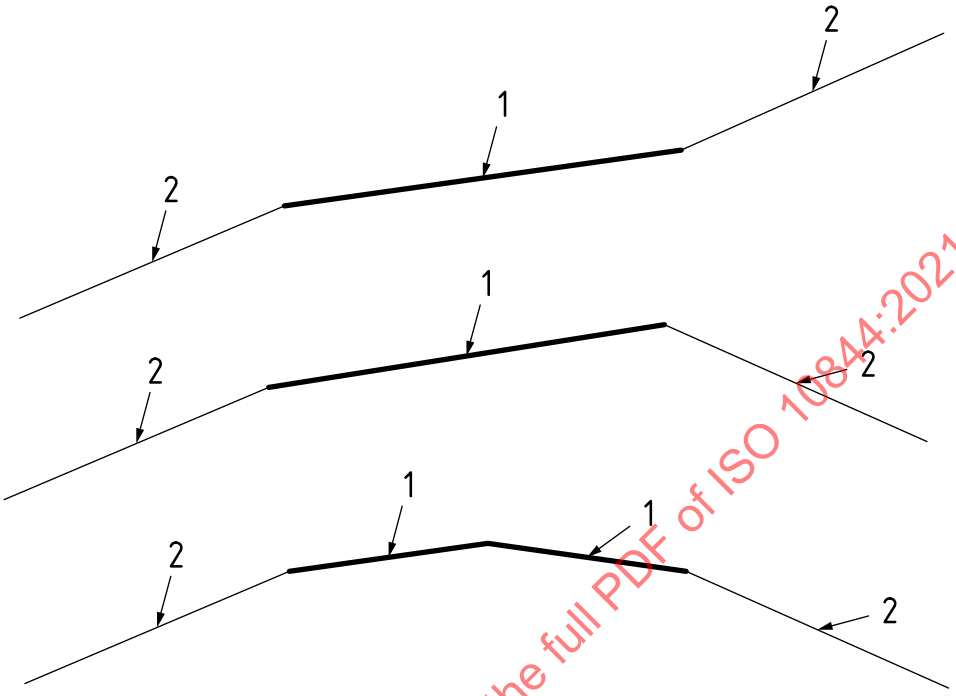
— drive lane cross fall shall be equal to or less than 1,0 % (see Figure 2);

— drive lane gradient shall be equal to or less than 0,5 %;

— propagation area cross fall shall be equal to or less than 2,0 % (see Figure 2);

— step from the edge of the drive lane to the propagation area shall not exceed 20 mm down or 5 mm up (see Figure 3).

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



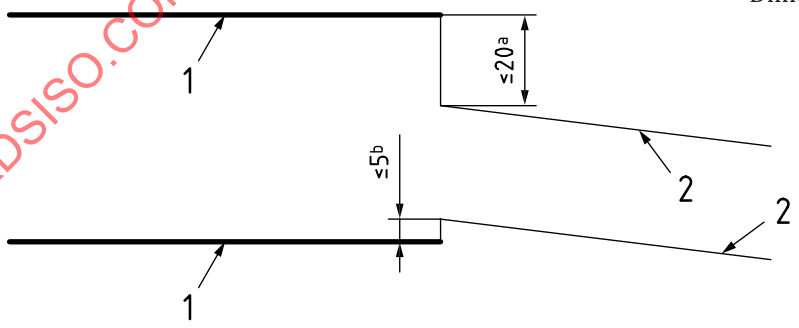
Key

1 drive lane 1,0 % maximum

2 propagation area 2,0 % maximum

Figure 2 — Cross fall examples

Dimensions in millimetres



Key

1 drive lane

2 propagation area

a Step down.

b Step up.

Figure 3 — Step from drive lane to propagation area

4.2 Surface properties

4.2.1 Irregularity

Conformity for irregularity shall be evaluated separately for the drive lane and propagation area.

Conformity shall be evaluated separately for transverse and longitudinal irregularity measurements.

Principal requirements for conformity include both:

— irregularity arithmetically averaged over all measurement points shall be equal to or less than the requirement;

— at least 80 % of all measurement points shall have irregularity equal to or less than the requirement.

4.2.1.1 Drive lane

The drive lane shall fulfil the following requirements for acceptance of the track only:

— transverse irregularity equal to or less than 3 mm;

— longitudinal irregularity equal to or less than 2 mm.

The drive lane shall fulfil the following requirements for periodic checking of the track only:

— transverse irregularity equal to or less than 5 mm;

— longitudinal irregularity equal to or less than 5 mm;

— if exclusively used for testing heavy vehicles, transverse irregularity equal to or less than 10 mm;

— if exclusively used for testing heavy vehicles, longitudinal irregularity equal to or less than 10 mm.

4.2.1.2 Propagation area

The propagation area shall fulfil the following requirements for acceptance of the track only:

— transverse irregularity equal to or less than 20 mm;

— longitudinal irregularity equal to or less than 20 mm.

4.2.2 Sound absorption

4.2.2.1 Drive lane

For each individual one-third-octave band from 315 Hz to 1 600 Hz, calculate an arithmetic average using the sound absorption from all measurement points. The average in each individual one-third octave band shall be equal to or less than 8 %.

At least 80 % of all measurement points shall have sound absorptions of all one-third-octave bands equal to or less than 8 %.

4.2.2.2 Propagation area

For each individual one-third-octave band from 315 Hz to 1 600 Hz, calculate an arithmetic average using the sound absorption from all measurement points. The average in each individual one-third octave band shall be equal to or less than 10 %.

At least 80 % of all measurement points shall have sound absorptions of all one-third-octave bands equal to or less than 10 %.

4.2.3 Texture

The surface of the drive lane shall have

a) an average mean profile depth (MPD) of 0,5 mm ± 0,2 mm, and

b) at least 80 % of all measured sections with an MPD of 0,5 mm ± 0,2 mm.

4.3 Material properties of the drive lane

The surface course of the drive lane shall

a) be dense asphalt concrete,

b) have a thickness greater than or equal to 30 mm, and

c) have an aggregate grading conforming to the aggregate grading envelope requirement in Table 2, verified using either

   — a minimum of one sieve size from each of the six sieve categories (sieve category 1 through 6), if there is no sieve size in sieve category 2 with an aggregate grading of 100 %, or

   — a minimum of one sieve size from sieve category 2 through 6, if there is at least one sieve size in sieve category 2 with an aggregate grading of 100 %.

   The recommended option is an aggregate grading of 100 % for at least one sieve size in sieve category 2;

d) have no elastic material (rubber, polyurethane, etc.) except for the modification of bitumen that is less than 1 % of the mass of the total asphalt mixture;

Sealing cracks with elastic material shall be permitted; however, materials and methods of installation shall be selected to minimize the impact to sound emission measurements.

NOTE 1 Alternative sieve sizes for each category accommodate test standards for aggregate grading which vary by country.

NOTE 2 Testing for sieve category 1 is not necessary if there is an aggregate grading test result of 100 % for any of the sieves in sieve category 2.

NOTE 3 Polymer-modified Bitumen (PmB) allows higher temperature operation and reduced surface wear.

Table 2 — Aggregate grading envelope

Sieve size mm	Aggregate grading envelope requirement %
Sieve category 1	
14,0	100
13,2	100
12,5	100
11,2	100
Sieve category 2	
10,0	100
9,5	95 to 100
8,0	86 to 100
6,7	79 to 100
6,3	76 to 100

Table 2 *(continued)*

Sieve size mm	Aggregate grading envelope requirement %
Sieve category 3	
5,6	71 to 99
5,0	65 to 95
4,75	63 to 93
4,0	56 to 87
Sieve category 4	
2,5	43 to 71
2,36	42 to 69
2,0	38 to 63
1,6	33 to 58
1,25	28 to 52
1,18	27 to 51
1,0	25 to 47
Sieve category 5	
0,63	20 to 37
0,60	20 to 36
0,50	18 to 32
0,425	17 to 30
0,315	15 to 25
0,30	15 to 25
0,25	14 to 22
Sieve category 6	
0,16	11 to 18
0,15	10 to 18
0,125	9 to 16
0,10	8 to 15
0,080	7 to 13
0,075	7 to 13
0,063	6 to 12

4.4 Conformity tests

a) Requirements shall be checked at the following occasions, and in accordance with Table 3:

1) acceptance of the track, which shall only be evaluated after construction and break-in of the track according to 4.5, but before vehicle sound emission measurements begin;

2) periodic checking of the track that was previously accepted as conforming to this document or the previous edition of this document.

NOTE 1 It is not necessary to evaluate an existing track for acceptance using this document if the track has previously been accepted using the previous edition of this document.

Table 3 — Periodicity for checking the requirements during acceptance and periodic checking of the track

Requirements for the track		For acceptance of the track		For periodic checking of the track	
		Drive lane	Propagation area	Drive lane	Propagation area
Slope	Gradient	× (0,5 %)	N.A.	N.A.	N.A.
	Cross fall	× (1,0 %)	× (2,0 %)	N.A.	N.A.
Longitudinal irregularity		× (≤2 mm)	× (≤20 mm)	× (≤5 or ≤ 10 mm)[b] 2 years[a]	N.A.
Transverse irregularity		× (≤3 mm)		× (≤5 or ≤ 10 mm)[b] 2 years[a]	N.A.
Texture (MPD) [c]		× (0,5 mm ± 0,2 mm)	N.A.	× (0,5 mm ± 0,2 mm) 2 years[a]	N.A.
Sound absorption		× (≤8 %)	× (≤10 %)	× (≤8 %) 4 years[a]	N.A.
Material properties of the drive lane		×	N.A.	N.A.	N.A.

× to be checked

N.A. not applicable

[a] Periodicity (maximum period between checking).

[b] 5 mm limit; 10 mm limit if track exclusively used for testing heavy vehicles.

[c] For test tracks with acceptance evaluated using mean profile depth calculated in conformity with a previous edition of ISO 13473-1, periodic checking may also be performed in the same way.

4.5 Break-in of the test track

The texture and sound absorption characteristics of the drive lane shall be checked not earlier than 4 weeks after paving or 1 000 vehicle passes after paving is complete.

If the surface is exclusively used for testing heavy vehicles, this break-in is not required.

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 sound measurements.

Loose debris or dust which could significantly impact the surface profile shall be removed from the surface.

Sealing of cracks is acceptable so long as acoustical performance of the test track is not affected.

See Annex A for recommendations.

5 Measurement methods and data processing

5.1 Measurement points

5.1.1 Drive lane

For sound absorption, irregularity, step, and texture measured using a non-continuous measurement (according to 5.3.1), measurement points shall be selected on the designated wheel tracks along the length of the drive lane as illustrated in Figure 4.

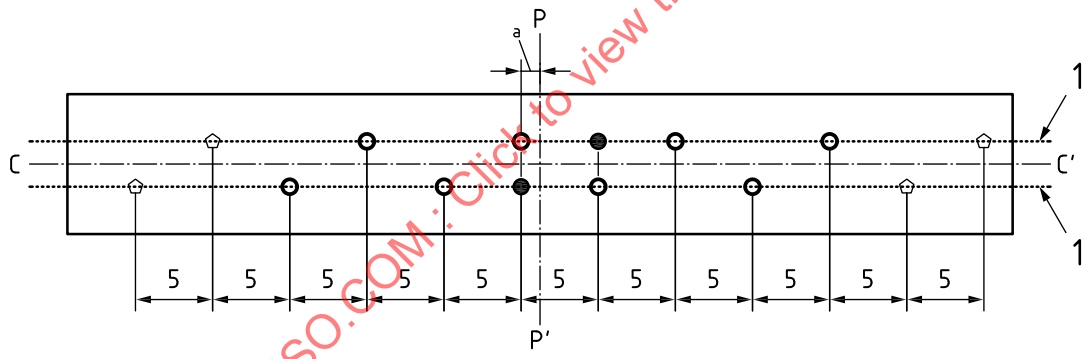
The first measurement point shall be selected randomly within ±1 m of PP' in the longitudinal direction. Additional measurement points shall be located at 5 m intervals from the first measurement point in the longitudinal direction.

Tracks with more than one designated wheel track shall distribute measurement points among the designated wheel tracks.

Tracks with more than one designated wheel track shall have additional measurement points selected for sound absorption and texture, located in all designated wheel tracks at the two 5 m intervals located within 5 m of PP' in the longitudinal direction.

If any randomly selected measurement point is not representative of the drive lane surface within the wheel track, or not suitable for accurate or representative sound absorption or texture testing (using a non-continuous measurement according to 5.3.1), the measurement point can be relocated to within ±0,3 m of the randomly selected point.

Dimensions in metres



Key

1 designated wheel track

○ required measurement point located PP' ± 20 m

● additional required measurement point for sound absorption and texture

⬠ additional measurement point, required at 5 m intervals if $l_a > 10$ m

CC' drive lane centre line (longitudinal axis)

PP' microphone line (transverse axis)

a First point random within ±1 m of PP'.

NOTE Example here illustrates 2 designated wheel tracks. Track can be evaluated for different number of designated wheel tracks

Figure 4 — Example of measurement points on drive lane with 2 designated wheel tracks

5.1.2 Propagation area

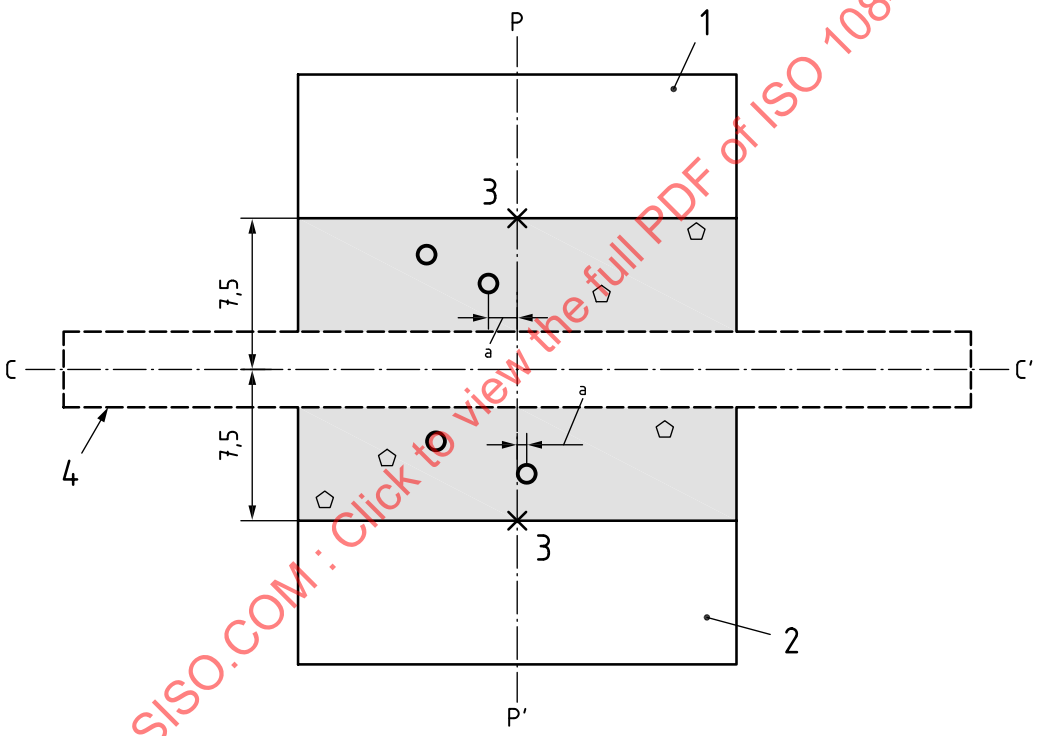
For sound absorption and irregularity testing in the propagation area, a minimum of two and maximum of five measurement points are required on each side of the drive lane.

One measurement point shall be selected on each side of the drive lane at a random distance in the transverse direction between the edge of the drive lane and 7,5 m from CC', and at a random distance in the longitudinal direction within a range of ±1 m of PP', as illustrated in Figure 5.

All remaining measurement points on each side of the drive lane shall be randomly selected within an area between the edge of the drive lane and 7,5 m from CC', and between −10 m and +10 m of PP'.

If any randomly selected measurement point is not representative of the propagation area surface, or not suitable for accurate or representative sound absorption testing, the measurement point can be relocated to within ±0,3 m of the randomly selected point.

Dimensions in metres



Key

1 propagation area side 1
2 propagation area side 2
3 microphone position
4 drive lane
measurement point selection area
required measurement points (2 per side)
optional measurement points (up to 3 per side)
CC' drive lane centre line (longitudinal axis)
PP' microphone line (transverse axis)
[a] Random within ±1 m of PP'.

NOTE Total number of measurement points of 2 to 5 per side

Figure 5 — Example of measurement points on propagation area

5.2 Irregularity measurement method

Irregularity shall be measured at all measurement points according to 5.1 and reported to the nearest 1 mm.

Irregularity may be evaluated with a straightedge according to EN 13036-7. Alternative methods for evaluating irregularity with an uncertainty of 0,5 mm or lower (at a 95 % confidence interval), and an interval between measurements of 0,3 m or lower shall be permitted.

5.3 Texture measurement methods

5.3.1 Texture profile measurement and MPD calculations

Texture profile shall be measured in sections. MPD shall be calculated for each section in accordance with ISO 13473-1. The measurement instrumentation shall conform to the requirements of class DE defined in ISO 13473-3.

Texture profile of the drive lane shall be measured by one of the following two options.

— Continuous measurement: Measure texture profile continuously over the entire length of the drive lane in each designated wheel track. Each texture profile shall be divided into 5 m long sections. MPD shall be calculated for each 5 m long section separately in each wheel track.

— Non-continuous measurement: Measure texture profile within 1 m of each measurement point illustrated in Figure 4. At each measurement point, a minimum section of 2,0 m of texture profile shall be measured. Individual texture profile measurements shall be at least 0,8 m long and positioned in a way which give statistically independent MPD values. MPD shall be calculated for each section.

Two repeat measurements shall be made of all texture profiles. For each profile section, the MPD calculated from repeat measurements shall be arithmetically averaged.

NOTE 1 Continuous measurement of texture profile is measured along a straight line within each designated wheel track (typically, along the centre of the designated wheel track). Continuous measurements are therefore not subjected to any transverse offset of measurement point selection according to 5.1.1.

NOTE 2 Using the continuous measurement method, a typical 40 m drive lane with two wheel tracks will result in MPD calculated for 16 sections. Using the non-continuous measurement method, a typical 40 m drive lane with two wheel tracks will result in MPD calculated for 8 sections.

5.3.2 Texture skewness and shape factor (g-factor) calculations (optional)

There are no requirements for skewness or shape factor (g-factor). However, skewness and shape factor (g-factor) correlate with tyre-to-road sound emission and may be used in the future for an analytical approach to track normalization.

Skewness of the texture profile should be evaluated according to ISO 13473-2.

Shape factor (g-factor) of the texture profile should be evaluated according to Annex B.

Individual skewness and shape factor (g-factor) calculations should be made for each 100 mm texture profile segment used to calculate MPD according to 5.3.1. Prior to calculating skewness or shape factor (g-factor), the data for each texture profile segment shall be processed in accordance with the data processing procedure in ISO 13473-1, except for low-pass filtering. Each 100 mm texture segment shall be brought to zero mean in adherence with ISO 13473-2. Detrending each texture segment by subtracting a least-squares fit is not necessary since slope suppression is accomplished through high-pass filtering within ISO 13473-1.

At each measurement point, report skewness and average shape factor (g-factor) by arithmetically averaging results from all 100 mm texture profile segments representative of that measurement point.

5.3.3 Texture spectrum calculations (optional)

There are no requirements for texture spectrum. However, texture spectrum correlates with tyre-to-road sound emission and may be used in the future for an analytical approach to track normalization.

Spectral analysis of the texture profile should be evaluated according to ISO 13473-4. Calculate and report one-third-octave band levels for texture wavelengths ranging from 5 mm to 100 mm.

5.4 Sound absorption measurement method

Sound absorption shall be measured at all measurement points according to 5.1 with an in situ device in accordance with ISO 13472-2. Results shall be reported as sound absorption for each one-third-octave-band from 315 Hz to 1 600 Hz, and according to the procedure described in ISO 13472-2.

5.5 Slope and step measurement methods

5.5.1 Gradient measurement

Gradient shall be measured with an uncertainty of 0,1 % or lower (at a 95 % confidence interval).

Gradient shall be measured and reported every 5 m along the edges of the drive lane and over the entire length of the drive lane, as illustrated in Figure 6. Gradient shall be calculated as the average slope of 5 m intervals between successive pairs of measurement points.

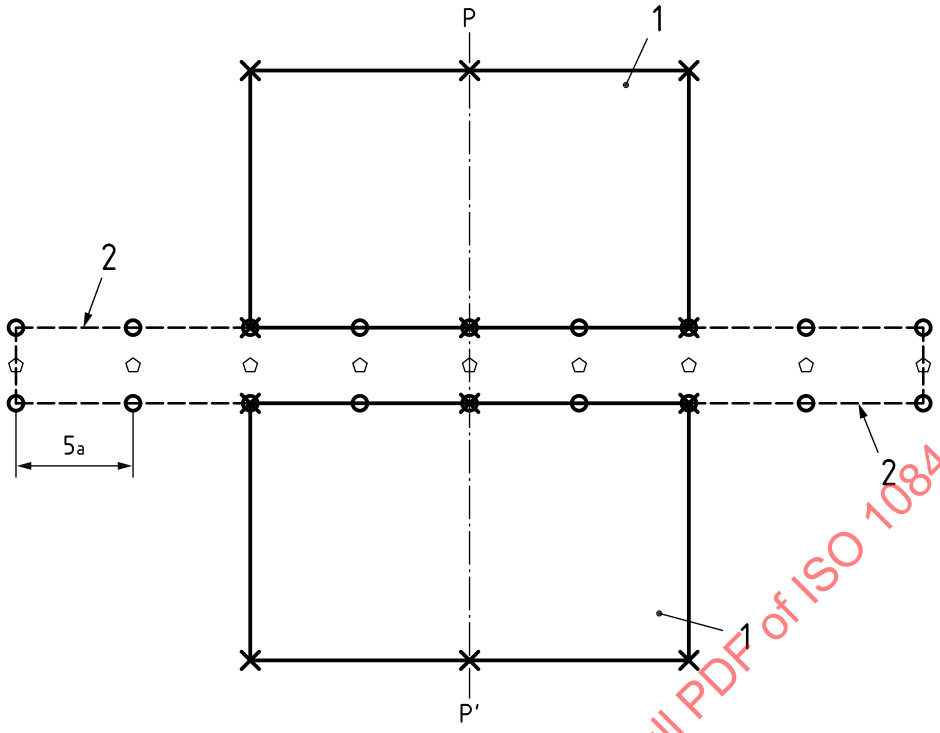
5.5.2 Cross fall measurement

Cross fall shall be measured with an uncertainty of 0,1 % or lower (at a 95 % confidence interval).

Cross fall of the drive lane shall be measured and reported every 5 m over the entire length of the drive lane, as illustrated in Figure 6. Cross fall shall be measured along the interval between measurement points from one side of the designated drive lane to the other. If the drive lane is designed with a high point not coinciding with an edge (e.g. "crown" or "roof" apex, as illustrated in the third example in Figure 2), then an additional interval shall be measured, to include this measurement location. Cross fall of the intervals on each side of the drive lane high point shall conform to the drive lane cross fall requirements.

Three cross fall measurements are required on each side of the propagation area, calculated as the average slope of the intervals between measurement points illustrated in Figure 6. One measurement shall be made along a transverse line ±1 m of PP'. An additional two measurements shall be made near the outside edges, located 9 to 10 m to both sides of PP'.

Dimensions in metres



Key

1	propagation area
2	drive lane
○	required measurement points for drive lane cross slope and gradient calculation
⬠	optional measurement points for drive lane cross slope calculation (if high point in drive lane not coinciding with an edge; e.g. crown/roof apex)
×	required measurement points for propagation area cross slope calculation
PP'	microphone line (transverse axis)
a	Spacing between drive lane measurement points.

NOTE 40 m total drive lane length shown ($l_a = 10$ m). Additional measurement points required for $l_a > 10$ m

Figure 6 — Measurement points for cross slope and gradient

5.5.3 Step measurement

Step shall be measured with an uncertainty of 1 mm or lower (at a 95 % confidence interval).

Step shall be measured at four locations along each edge of the drive lane, for a total of eight step measurement locations. Measurements shall be made across the boundary between the edge of drive lane and propagation area, at locations closest to each drive lane measurement point according to 5.1.1.

5.6 Aggregate grading measurement method

Test aggregates extracted from asphalt mixture that are combined from a minimum of four samples.

Collect samples by one of two methods:

— loose mixed asphalt sampled from material being placed in the drive lane surface course;

— asphalt material recovered from cores drilled through the paved surface course, preferably at 10 m intervals on the drive lane run-up section and outside the wheel tracks.

5.7 Bitumen modification elastic material measurement method

If the bitumen has been modified to include elastic material (e.g., SBS or rubber), the total elastic material content in the asphalt mixture shall be determined as follows:

— determine either an actual or maximum quantity of elastic material in the bitumen, expressed as a percentage by mass, as reported in a customary product certificate or authorized letter from the bitumen supplier;

— determine the quantity of bitumen in the asphalt mixture, expressed as a percentage by mass, as reported in a laboratory analysis of asphalt mixture sampled according to 5.6;

— calculate the quantity of elastic material of the asphalt mixture, expressed as a percentage by mass, by multiplying the quantity of elastic material in the bitumen with the quantity of bitumen in the asphalt mixture.

NOTE Instead of determining an exact quantity of elastic material in the bitumen, it is acceptable to determine a declared maximum quantity of elastic material in the bitumen. Regardless if the quantity of elastic material is exact or a maximum, the calculated quantity of elastic material of the asphalt mixture conforms to this document.

5.8 Surface course thickness measurement method

Determine surface course thickness using standard methods used in road construction practice. If cores are used to determine surface course thickness, extract the cores according to 5.6.

6 Conformity report

The test report for each pavement test surface shall contain all the information required for the acceptance or periodic checking of the track, whichever is applicable.

a) General information:

- owner;
- contractor's name (optional);
- date of the construction of the test track (optional);
- location of the test track;
- certifying authority (if applicable);
- certification status;
- main use of the test track (e.g. truck tyre coast by, testing, passenger car drive by);
- designation if track shall be exclusively used for testing heavy vehicles;
- notable features (e.g. under track heating);

b) Size and geometry:

1) size:

i) dimensions of the drive lane;

- total length (m);
- width (m);
- designated wheel tracks, as measured from the centre of drive lane (m);

- drive lane extensions on each end of the drive lane, l_a (m);
- construction run-up sections on each end of the drive lane, l_s (m) (if applicable);

ii) dimensions of the propagation area:

- length (m);
- width (m);

iii) free space:

- minimum distance from large reflecting objects (m);
- other notable features (if applicable);

2) geometry:

i) drive lane:

- cross fall (%);
- measurement intervals conforming to cross fall requirement (%);
- gradient (%);
- measurement intervals conforming to gradient requirement (%);

ii) propagation area:

- cross fall (%);
- measurement intervals conforming to cross fall requirement (%);

iii) step between drive lane and propagation area:

- step (mm);
- measurement points conforming to the step requirement (%);

c) Surface properties and sound absorption:

1) drive lane:

- transverse irregularity (mm);
- measurement points conforming to transverse irregularity requirement (%);
- longitudinal irregularity (mm);
- measurement points conforming to longitudinal irregularity requirement (%);
- sound absorption (%);
- measurement points conforming to sound absorption requirement (%);
- texture, MPD (mm);
- measured sections conforming to texture requirement (%);
- skewness (optional);
- shape factor (g-factor) (optional);
- texture spectrum (optional);

2) propagation area:
   - transverse irregularity (mm);
   - measurement points conforming to transverse irregularity requirement (%);
   - longitudinal irregularity (mm);
   - measurement points conforming to longitudinal irregularity requirement (%);
   - sound absorption (%);
   - measurement points conforming to sound absorption requirement (%);

d) Material properties of the drive lane:
   - thickness of surface course (mm);
   - aggregate grading (% passing for all control sieves);
   - elastic material (% of the mass of the total asphalt mixture) (if applicable);

e) Proving the requirements:
   - selection and location of all measurement points and intervals;
   - description of all measuring devices;
   - description of all measuring methods.

7 Summary of improvements on the 2014 edition

Annex C lists the improvements made compared to the previous edition of this document.

Annex A
(informative)

Maintenance and stability of acoustic performance of test surface over time

A.1 General

This annex gives information on maintaining the test track and on stability with time of the test track.

A.2 Maintenance

In the process of cleaning, devices that can alter the texture such as rotating steel brushes and high pressure water spray are not recommended. Dust should be vacuumed or brushed off.

Salt can alter the surface temporarily or even permanently in such a way as to increase sound and therefore, application of salt is not recommended.

A.3 Influence of age

The surface will achieve its required characteristics approximately 4 weeks after the construction, or after sufficient crossings are made in order to remove the bitumen cover from the mineral surface.

It is common for the tyre or road sound levels measured on the test surface to increase slightly during the first 6 months to 12 months after the construction.

The influence of age on the sound from trucks is generally less than that from cars.

The surface wears out depending on the frequency of use mainly in the wheel tracks (ravelling and rutting) and as a consequence, the acoustic properties can be affected.

The stiffness of the base and subgrade can influence the durability of the track.

When the track surface is hot, additional damage can occur.

Avoid conducting tests when the surface temperature is over 50 °C, unless the track is specifically designed for operation above this temperature.

For use at higher surface temperatures, this edition of this International Standard allows the use of Polymer-modified Bitumen.

A.4 Repaving the test area

When necessary to repave the test track drive lane, it is unnecessary to repave more than the test strip of 3 m in width, where vehicles are driving, provided the test area outside the strip meets the requirements for sound absorption.

The whole width of the drive lane should always be renewed according to the width of the finisher or the milling machine. Additional longitudinal joints should be avoided.

Annex B
(informative)

Method of calculation of shape factor (g-factor)

The shape factor (or g-factor) is a texture metric describing the skewness of texture using a bearing area curve, also referred to as an Abbott-Firestone curve.

Calculate the shape factor (g-factor) as follows:

B.1 Step 1: Identify texture profile data segments

Process texture profile data according to the data processing procedure in ISO 13473-1, except for low-pass filtering.

Extract individual 100 mm long texture profile segments from these processed texture profile data.

Each 100 mm texture profile segment shall be brought to zero mean in adherence with ISO 13473-2. Detrending each texture segment by subtracting a least-squares fit is not necessary since slope suppression is accomplished through high-pass filtering within ISO 13473-1. Example data from an individual 100 mm texture profile segment is illustrated in Figure B.1.