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**Economic Commission for Europe****Inland Transport Committee****World Forum for Harmonization of Vehicle Regulations****Working Party on Noise****Fifty-seventh session**

Geneva, 5–7 February 2013

Item 6 of the provisional agenda

**Regulation No. 117 (Tyre rolling noise and wet grip adhesion)****Proposal for 03 series of amendments to Regulation No. 117****Submitted by the Chair and Vice-chair of the Working Party on Noise<sup>1</sup>**

The text reproduced below was proposed by the Chair and Vice-Chair of GRB to allow the use of the test track complying with ISO 10844:2011 in a new series of amendments to the UN Regulation. The proposal is based on a document without symbol (GRB-56-20) distributed at the fifty-sixth session of the Working Party on Noise (GRB)(ECE/TRANS/WP.29/GRB/54, para. 19). The modification to the existing text of the UN Regulation, are marked in bold for new or strikethrough for deleted characters.

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<sup>1</sup> In accordance with the programme of work of the Inland Transport Committee for 2010–2014 (ECE/TRANS/208, para. 106 and ECE/TRANS/2010/8, programme activity 02.4), the World Forum will develop, harmonize and update Regulations in order to enhance the performance of vehicles. The present document is submitted in conformity with that mandate.

## I. Proposal

*Insert new paragraphs 12.8. to 12.10., to read:*

- "12.8. As from the official date of entry into force of the 03 series of amendments, no Contracting Party applying this Regulation shall refuse to grant type approval under this Regulation as amended by the 03 series of amendments.**
- 12.9. As from 60 months after the date of entry into force of the 03 series of amendments, Contracting Parties applying this Regulation shall grant type approvals only if the type of tyre to be approved meets the requirements of this Regulation as amended by the 03 series of amendments.**
- 12.10. Even after the entry into force of the 03 series of amendments to this Regulation, UN type approvals of tyres to the preceding series of amendments to the Regulation shall remain valid and Contracting Parties applying this Regulation shall continue to accept them."**

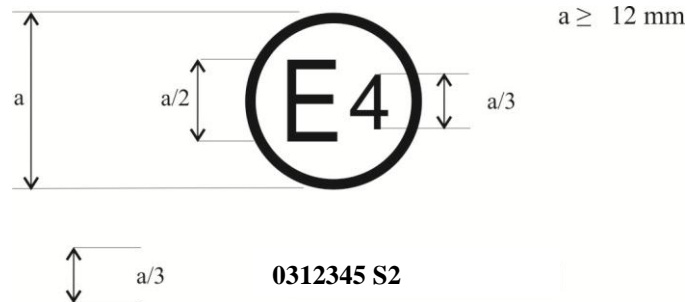
*Annex 2, Appendix 1, Example of Approval Marks, amend to read:*

"Arrangement of approval Marks

(See paragraph 5.4. to this Regulation)

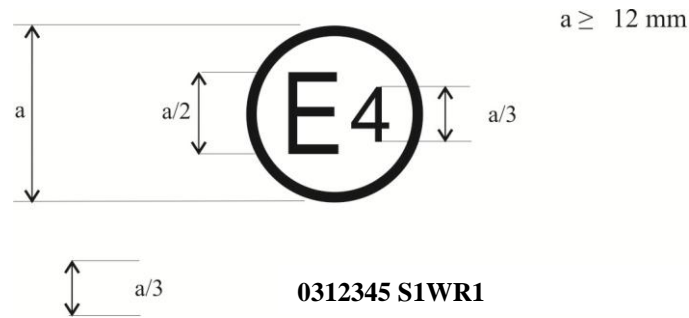
Approval according to Regulation No. 117

Example 1



The above approval mark, affixed to a pneumatic tyre shows that a tyre concerned has been approved in the Netherlands (E4) pursuant to Regulation No. 117 (marked by S2 (rolling sound at stage 2) only), under approval number 0312345. The first two digits of the approval number (03) indicate that the approval was granted according to the requirements 03 series of amendments of this Regulation.

Example 2

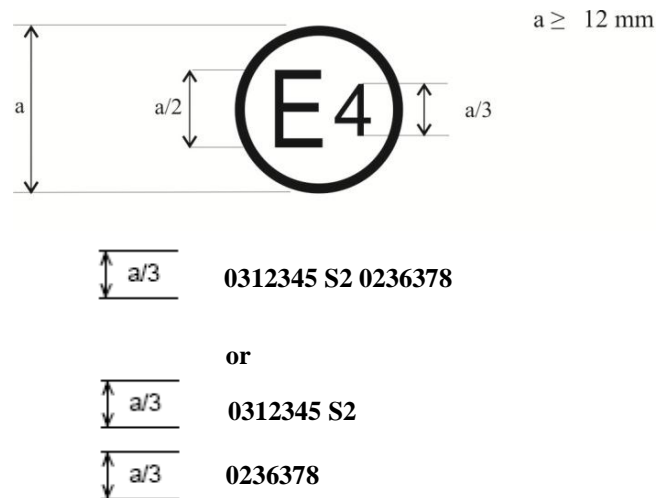


The above approval mark shows that the tyre concerned has been approved in the Netherlands (E4) pursuant to Regulation No. 117 (marked by S1 (rolling sound at stage 1) W (wet adhesion), and R1 (Rolling resistance at stage 1) under approval number 0312345. This indicates that the approval is for S1WR1. The first two digits of the approval number (03) indicate that the approval was granted according to the requirements of the 03 series of amendments of this Regulation."

*Annex 2, Appendix 2, amend to read:*

**"Approval according to Regulation No. 117 coincident with approval to Regulation No. 30 or 54<sup>2</sup>**

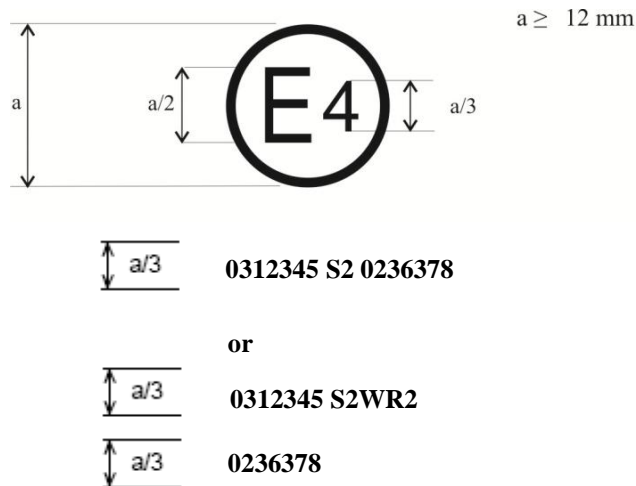
Example 1



The above approval mark shows that the tyre concerned has been approved in the Netherlands (E4) pursuant to Regulation No. 117 (marked by S2 (rolling sound at stage 2)), under approval number 0312345 and Regulation No. 30, under approval number 0236378. The first two digits of the approval number (03) indicate that the approval was granted according to the 03 series of amendments and Regulation No. 30 included the 02 series of amendments.

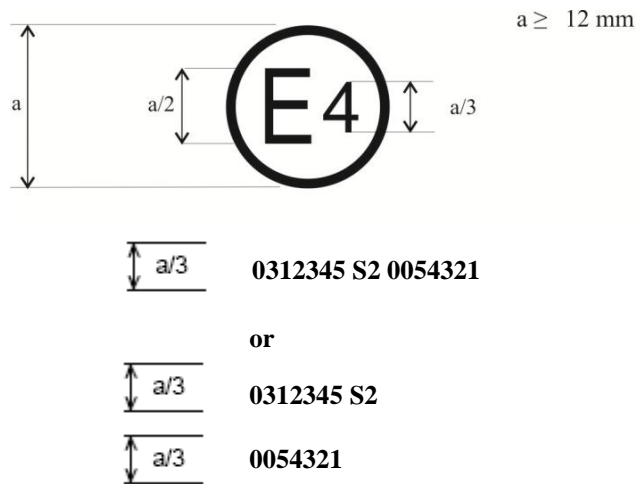
<sup>2</sup> Approvals in accordance with Regulation No. 117 for tyres within the scope of Regulation No. 54 currently do not include wet adhesion requirements.

Example 2



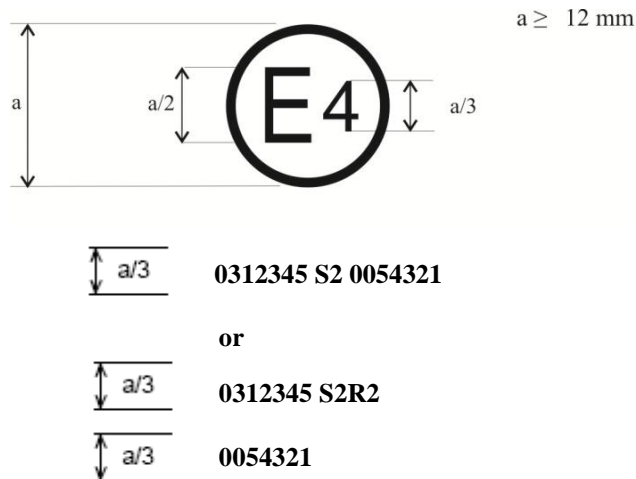
The above approval mark shows that the tyre concerned has been approved in the Netherlands (E4) pursuant to Regulation No. 117 (marked by S2WR2 (rolling sound at stage 2 wet adhesion and rolling resistance at stage 2)), under approval number 0312345 and Regulation No. 30 under approval number 0236378. The first two digits of the approval number (03) indicate that the approval was granted according to the 03 series of amendments and Regulation No. 30 included the 02 series of amendments.

Example 3



The above approval mark shows that the tyre concerned has been approved in the Netherlands (E4) pursuant to Regulation No. 117 and the 03 series of amendments under approval number 0312345 (marked by S2), and Regulation No. 54. This indicates that the approval is for rolling sound stage 2 (S2). The first two digits of the Regulation No. 117 approval number (03) in conjunction with "S2" indicate that the first approval was granted in accordance with Regulation No. 117 which included the 03 series of amendments. The first two digits of Regulation No. 54 (00) indicate that this Regulation was in its original form.

## Example 4

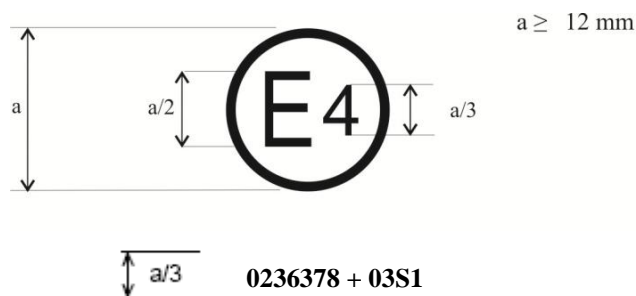


The above approval mark shows that the tyre concerned has been approved in the Netherlands (E4) pursuant to Regulation No. 117 and the 03 series of amendments under approval number 0312345 (marked by S2 R2), and Regulation No. 54. This indicates that the approval is for rolling sound stage 2 (S2) and rolling resistance stage 2. The first two digits of the Regulation No. 117 approval number (03) in conjunction with "S2R2" indicate that the first approval was granted in accordance with Regulation No. 117 which included the 03 series of amendments. The first two digits of Regulation No. 54 (00) indicate that this Regulation was in its original form."

*Annex 2, Appendix 3, amend to read:*

### "Extensions to combine approvals issued in accordance with Regulations Nos. 117, 30 or 54<sup>3</sup>

## Example 1

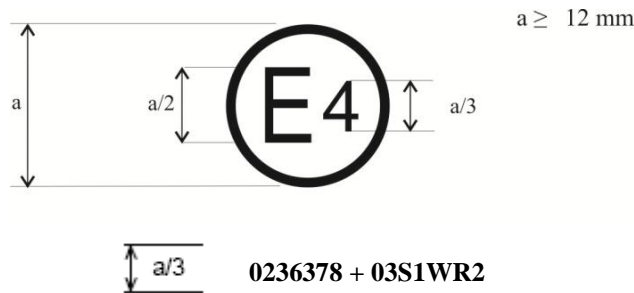


The above approval mark shows that the tyre concerned has been initially approved in the Netherlands (E4) pursuant to Regulation No. 30 and the 02 series of amendments under approval number 0236378. It is also marked by + 03S1 (rolling sound at stage 1) which indicates that its approval is extended under Regulation No. 117 (03 series of amendments). The first two digits of the approval number (02) indicate that the approval was granted according to Regulation No. 30 (02 series of amendments). The addition (+) sign indicates

<sup>3</sup> Approvals in accordance with Regulation No. 117 for tyres within the scope of Regulation No. 54 currently do not include wet adhesion requirements.

that the first approval was granted in accordance with Regulation No. 30 and has been extended to include the approval(s) granted according to Regulation No. 117 (03 series of amendments) for rolling sound at stage 1.

Example 2

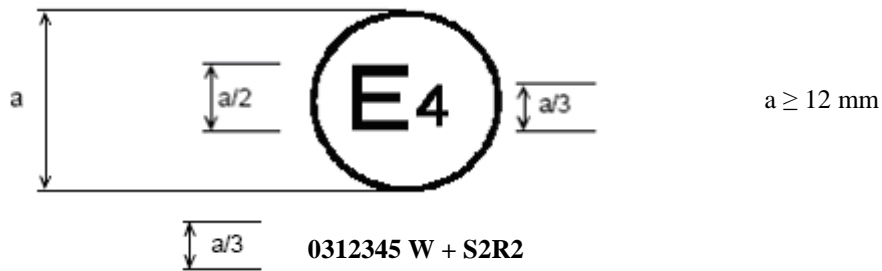


The above approval mark shows that the tyre concerned has been initially approved in the Netherlands (E4) pursuant to Regulation No. 30 and the 02 series of amendments under approval number 0236378. This indicates that the approval is for S1 (rolling sound at stage 1) W (wet adhesion) and R2 (rolling resistance at stage 2). The S1WR2 preceded by (03) indicates that it has had its approval extended under Regulation No. 117 which included the 03 series of amendments. The first two digits of the approval number (02) indicate that the approval was granted according to Regulation No. 30 (02 series of amendments). The addition (+) sign indicates that the first approval was granted in accordance with Regulation No. 30 and has been extended to include Regulation No. 117 approval(s) (03 series of amendments)"

Annex 2, Appendix 4, amend to read:

**"Extensions to combine approvals issued in accordance with Regulation No. 117<sup>4</sup>**

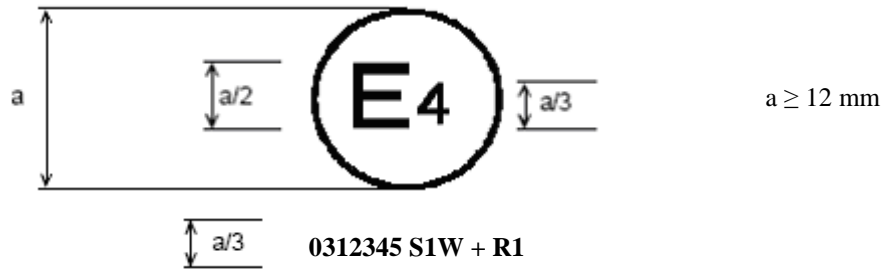
Example 1



The above approval mark shows that the tyre concerned has been initially approved in the Netherlands (E4) pursuant to Regulation No. 117 and the 03 series of amendments under approval number 0312345. This indicates that the approval is for W (wet grip). The S2R2 preceded by + indicates that it has had its approval extended under Regulation No. 117 to rolling sound at stage 2 and rolling resistance at stage 2 based on separate certificate(s).

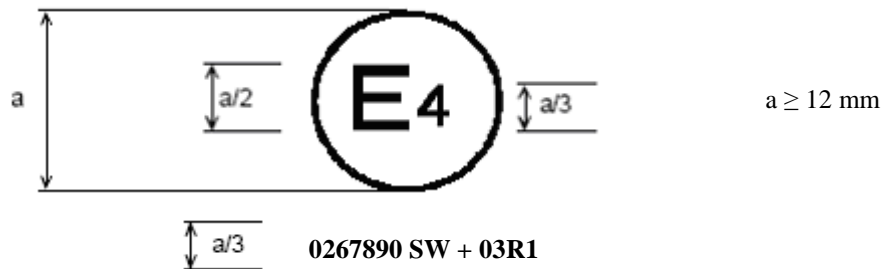
<sup>4</sup> Approvals in accordance with Regulation No. 117 for tyres within the scope of Regulation No. 54 currently do not include wet adhesion requirements.

## Example 2



The above approval mark shows that the tyre concerned has been initially approved in the Netherlands (E4) pursuant to Regulation No. 117 and the 03 series of amendments under approval number 0312345. This indicates that the approval is for S1 (rolling sound at stage 1) and W (wet grip). The R1 preceded by + indicates that it has had its approval extended under Regulation No. 117 to rolling resistance at stage 1 based on separate certificate(s).

## Example 3



The above approval mark shows that the tyre concerned has been initially approved in the Netherlands (E4) pursuant to Regulation No. 117 and the 02 series of amendments under approval number 0267890. This indicates that the approval is for S (rolling sound at stage 1) and W (wet grip). The 03R1 preceded by + indicates that it has had its approval extended under Regulation No. 117 and the 03 series of amendments to rolling resistance at stage 1 based on separate certificate(s)."

*Annex 3, paragraph 2.1, amend to read:*

## "2.1. Test site

The test site shall consist of a central section surrounded by a substantially flat test area. The measuring section shall be level; the test surface shall be dry and clean for all measurements. The test surface shall not be artificially cooled during or prior the testing.

The test track shall be such that the conditions of a free sound field between the sound source and the microphone are attained to within 1 dB(A). These conditions shall be deemed to be met if there are no large sound reflecting objects, such as fences, rocks, bridges or building within 50 m of the centre of the measuring section. The surface of the test track and the dimensions of the test site shall be in accordance with **ISO 10844:2011**.

A central part of at least..."

*Annex 3, Appendix 1, Part 2,*

*Insert a new item 3.2., to read:*

**"3.2. Date of track certification to ISO 10844:2011: ....."**

*Items 3.2. and 3.3., renumber as items 3.3. and 3.4.*

*Annex 4, shall be deleted*

## II. Proposal

*Insert new paragraphs 12.8. and 12.10., to read:*

**"12.8. As from the official date of entry into force of the 03 series of amendments, no Contracting Party applying this Regulation shall refuse to grant type approval under this Regulation as amended by the 03 series of amendments.**

**12.9. As from 60 months after the date of entry into force of the 03 series of amendments, Contracting Parties applying this Regulation shall grant type approvals only if the type of tyre to be approved meets the requirements of this Regulation as amended by the 03 series of amendments."**

**12.10. Even after the entry into force of the 03 series of amendments to this Regulation, UN type approvals of tyres to the preceding series of amendments to the Regulation shall remain valid and Contracting Parties applying this Regulation shall continue to accept them."**

*Annex 2, Appendix 1 to 4, Example of Approval Marks, amend as for Proposal I above*

*Annex 3, paragraph 2.1, amend to read:*

**"2.1. Test site**

The test site shall consist of a central section surrounded by a substantially flat test area. The measuring section shall be level; the test surface shall be dry and clean for all measurements. The test surface shall not be artificially cooled during or prior the testing.

The test track shall be such that the conditions of a free sound field between the sound source and the microphone are attained to within 1 dB(A). These conditions shall be deemed to be met if there are no large sound reflecting objects, such as fences, rocks, bridges or building within 50 m of the centre of the measuring section. The surface of the test track and the dimensions of the test site shall be in accordance with **Annex 4.**

*Annex 4, amend to read:*

### **Specifications for the test site**

~~1. Introduction~~

~~————— This annex describes the specifications relating to the physical characteristics and the laying of the test track. These specifications based on a special~~



standard<sup>5</sup> describe the required physical characteristics as well as the test methods for these characteristics.

## 2. Required characteristics of the surface

A surface is considered to conform to this standard provided that the texture and voids content or sound absorption coefficient have been measured and found to fulfil all the requirements of paragraphs 2.1. to 2.4. below and provided that the design requirements (paragraph 3.2.) have been met.

### 2.1. Residual voids content

The residual voids content (VC) of the test track paving mixture shall not exceed 8 per cent. For the measurement procedure, see paragraph 4.1.

### 2.2. Sound absorption coefficient

If the surface fails to comply with the residual voids content requirement, the surface is acceptable only if its sound absorption coefficient  $\alpha \leq 0.10$ . For the measurement procedure, see paragraph 4.2. The requirement of paragraphs 2.1. and 2.2. is met also if only sound absorption has been measured and found to be  $\alpha \leq 0.10$ .

*Note:* The most relevant characteristic is the sound absorption, although the residual voids content is more familiar among road constructors. However, sound absorption needs to be measured only if the surface fails to comply with the voids requirement. This is motivated because the latter is connected with relatively large uncertainties in terms of both measurements and relevance and some surfaces therefore erroneously may be rejected when based only on the voids measurement.

### 2.3. Texture depth

The texture depth (TD) measured according to the volumetric method (see paragraph 4.3. below) shall be:

$$TD \geq 0.4 \text{ mm}$$

### 2.4. Homogeneity of the surface

Every practical effort shall be taken to ensure that the surface is made to be as homogeneous as possible within the test area. This includes the texture and voids content, but it should also be observed that if the rolling process results in more effective rolling at some places than others, the texture may be different and unevenness causing bumps may also occur.

### 2.5. Period of testing

In order to check whether the surface continues to conform to the texture and voids content or sound absorption requirements stipulated in this standard, periodic testing of the surface shall be done at the following intervals:

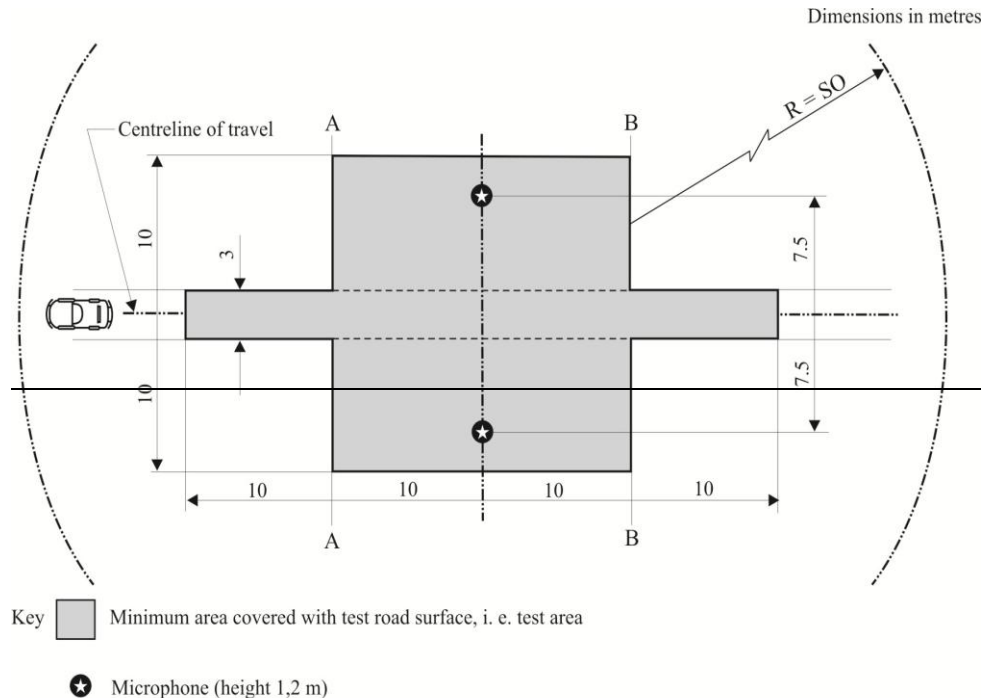
(a) For residual voids content (VC) or sound absorption ( $\alpha$ ):

When the surface is new:

<sup>5</sup> ISO 10844:1994.

- \_\_\_\_\_ If the surface meets the requirements when new, no further periodical testing is required. If it does not meet the requirement when it is new, it may do so later because surfaces tend to become clogged and compacted with time;
- \_\_\_\_\_ (b) For texture depth (TD):
- \_\_\_\_\_ When the surface is new:
- \_\_\_\_\_ When the noise testing starts (*Note*: not before four weeks after laying);
- \_\_\_\_\_ Then every twelve months.
- 3. Test surface design
- 3.1. Area
- \_\_\_\_\_ When designing the test track layout it is important to ensure that, as a minimum requirement, the area traversed by the vehicles running through the test strip is covered with the specified test material with suitable margins for safe and practical driving. This will require that the width of the track is at least 3 m and the length of the track extends beyond lines AA and BB by at least 10 m at either end. Figure 1 shows a plan of a suitable test site and indicates the minimum area which shall be machine laid and machine compacted with the specified test surface material. According to Annex 3, paragraph 3.2., measurements have to be made on each side of the vehicle. This can be made either by measuring with two microphone locations (one on each side of the track) and driving in one direction, or measuring with a microphone only on one side of the track but driving the vehicle in two directions. If the latter method is used, then there are no surface requirements on that side of the track where there is no microphone.

Figure 1  
**Minimum requirements for test surface area. The shaded part is called "Test Area"**



NOTE - There shall be no large acoustically reflective objects within this radius.

~~3.2. Design and preparation of the surface~~

~~3.2.1. Basic design requirements~~

~~The test surface shall meet four design requirements:~~

~~3.2.1.1. It shall be a dense asphaltic concrete.~~

~~3.2.1.2. The maximum chipping size shall be 8 mm (tolerances allow from 6.3 mm to 10 mm).~~

~~3.2. Design and preparation of the surface~~

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~~The test surface shall meet four design requirements:~~

~~3.2.1.1. It shall be a dense asphaltic concrete.~~

~~3.2.1.2. The maximum chipping size shall be 8 mm (tolerances allow from 6.3 mm to 10 mm).~~

~~3.2.1.3. The thickness of the wearing course shall be  $\geq 30$  mm.~~

~~3.2.1.4. The binder shall be a straight penetration grade bitumen without modification.~~

~~3.2.2. Design guidelines~~

~~As a guide to the surface constructor, an aggregate grading curve which will give desired characteristics is shown in Figure 2. In addition, Table 1 gives some guidelines in order to obtain the desired texture and durability. The grading curve fits the following formula:~~

$$P(\% \text{ passing}) = 100 - (d/d_{\max})^{1/2}$$

~~Where:~~

~~$d$  = square mesh sieve size, in mm~~

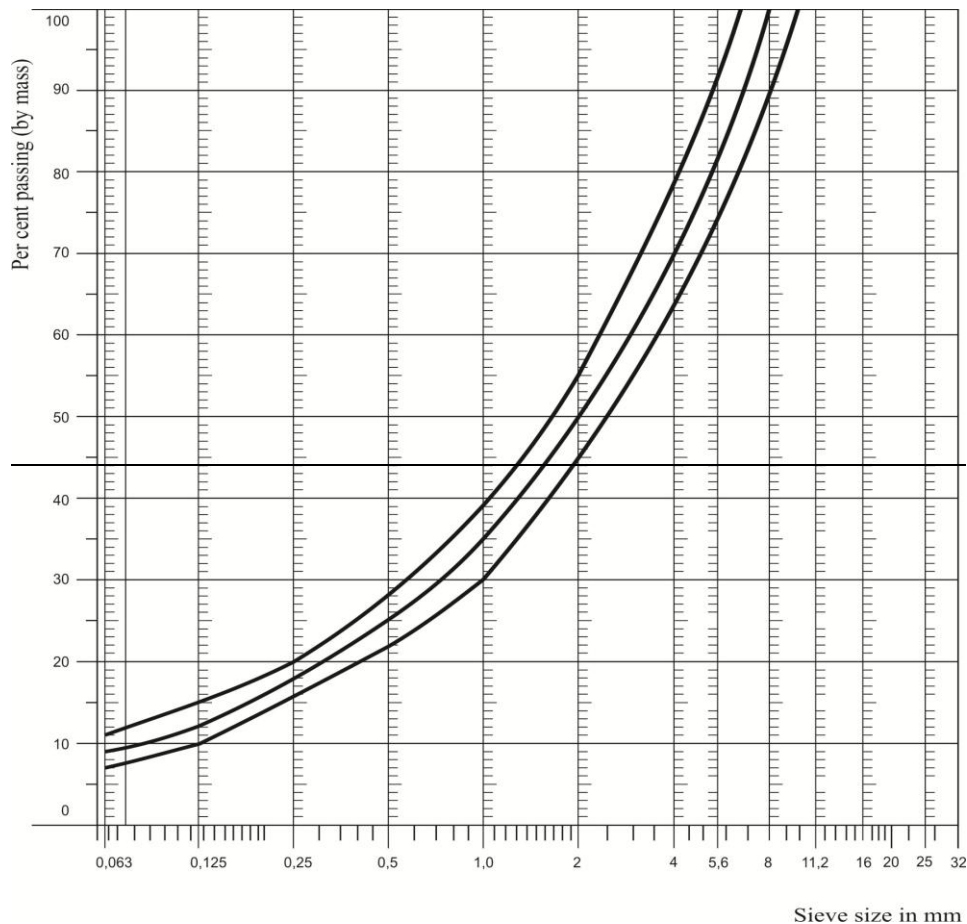
~~$d_{\max}$  = 8 mm for the mean curve~~

~~= 10 mm for the lower tolerance curve~~

~~= 6.3 mm for the upper tolerance curve~~

~~Figure 2~~

~~**Grading curve of the aggregate in the asphaltic mix with tolerances**~~



In addition to the above, the following recommendations are given:

- ~~(a) The sand fraction (0.063 mm < square mesh sieve size < 2 mm) shall include no more than 55 per cent natural sand and at least 45 per cent crushed sand;~~
- ~~(b) The base and sub base shall ensure a good stability and evenness, according to best road construction practice;~~
- ~~(c) The chippings shall be crushed (100 per cent crushed faces) and of a material with a high resistance to crushing;~~
- ~~(d) The chippings used in the mix shall be washed;~~
- ~~(e) No extra chippings shall be added onto the surface;~~
- ~~(f) The binder hardness expressed as PEN value shall be 40–60, 60–80 or even 80–100 depending on the climatic conditions of the country. The rule is that as hard a binder as possible shall be used, provided this is consistent with common practice;~~
- ~~(g) The temperature of the mix before rolling shall be chosen so as to achieve by subsequent rolling the required voids content. In order to increase the probability of satisfying the specifications of paragraphs 2.1. to 2.4. above, the compactness shall be studied not only by an appropriate choice of mixing temperature, but also by an appropriate number of passings and by the choice of compacting vehicle.~~

Table 1  
Design guidelines

	Target values		Tolerances
	By total mass of mix	By mass of the aggregate	
Mass of stones, square mesh sieve (SM) > 2 mm	47.6 %	50.5 %	±5 %
Mass of sand — 0.063 < SM < 2 mm	38.0 %	40.2 %	±5 %
Mass of filler — SM < 0.063 mm	8.8 %	9.3 %	±5 %
Mass of binder (bitumen)	5.8 %	N.A.	±0.5 %
Max. chipping size	8 mm		6.3 – 10 mm
Binder hardness	(see paragraph 3.2.2. (f))		
Polished stone value (PSV)	≥ 50		
Compactness, relative to Marshall Compactness	98 %		

#### 4. Test method

##### 4.1. Measurement of the residual voids content

For the purpose of this measurement, cores have to be taken from the track in at least four different positions, which are equally distributed in the test area between lines AA and BB (see Figure 1). In order to avoid inhomogeneity and unevenness in the wheel tracks, cores should not be taken in wheel tracks themselves, but close to them. Two cores (minimum) should be taken close to the wheel tracks and one core (minimum) should be taken approximately midway between the wheel tracks and each microphone location.

If there is a suspicion that the condition of homogeneity is not met (see paragraph 2.4.), cores shall be taken from more locations within the test area.

The residual voids content has to be determined for each core, then the average value from all cores shall be calculated and compared with the requirement of paragraph 2.1. In addition, no single core shall have a voids value, which is higher than 10 per cent.

The test surface constructor is reminded of the problem, which may arise when the test area is heated by pipes or electrical wires and cores shall be taken from this area. Such installations shall be carefully planned with respect to future core drilling locations. It is recommended to leave a few locations of size approximately 200 mm x 300 mm where there are no wires/pipes or where the latter are located deep enough in order not to be damaged by cores taken from the surface layer.

##### 4.2. Sound absorption coefficient

The sound absorption coefficient (normal incidence) shall be measured by the impedance tube method using the procedure specified in ISO 10534 1:1996 or ISO 10534 2:1998.

- ~~Regarding test specimens, the same requirements shall be followed as regarding the residual voids content (see paragraph 4.1.). The sound absorption shall be measured in the range between 400 Hz and 800 Hz and in the range between 800 Hz and 1,600 Hz (at least at the centre frequencies of third octave bands) and the maximum values shall be identified for both of these frequency ranges. Then these values, for all test cores, shall be averaged to constitute the final result.~~
- 4.3. ~~Volumetric macro texture measurement~~
- ~~For the purpose of this standard, texture depth measurements shall be made on at least 10 positions evenly spaced along the wheel tracks of the test strip and the average value taken to compare with the specified minimum texture depth. See Standard ISO 10844:1994 for description of the procedure.~~
5. ~~Stability in time and maintenance~~
- 5.1. ~~Age influence~~
- ~~In common with any other surfaces, it is expected that the tyre rolling sound level measured on the test surface may increase slightly during the first 6-12 months after construction.~~
- ~~The surface will achieve its required characteristics not earlier than four weeks after construction. The influence of age on the noise from trucks is generally less than that from cars.~~
- ~~The stability over time is determined mainly by the polishing and compaction by vehicles driving on the surface. It shall be periodically checked as stated in paragraph 2.5.~~
- 5.2. ~~Maintenance of the surface~~
- ~~Loose debris or dust, which could significantly reduce the effective texture depth shall be removed from the surface. In countries with winter climates, salt is sometimes used for de-icing. Salt may alter the surface temporarily or even permanently in such a way as to increase noise and is therefore not recommended.~~
- 5.3. ~~Repaving the test area~~
- ~~If it is necessary to repave the test track, it is usually unnecessary to repave more than the test strip (of 3 m width in Figure 1) where vehicles are driving, provided the test area outside the strip met the requirement of residual voids content or sound absorption when it was measured.~~
6. ~~Documentation of the test surface and of tests performed on it~~
- 6.1. ~~Documentation of the test surface~~
- ~~The following data shall be given in a document describing the test surface:~~
- 6.1.1. ~~The location of the test track;~~
- 6.1.2. ~~Type of binder, binder hardness, type of aggregate, maximum theoretical density of the concrete (DR), thickness of the wearing course and grading curve determined from cores from the test track;~~
- 6.1.3. ~~Method of compaction (e.g. type of roller, roller mass, number of passes);~~
- 6.1.4. ~~Temperature of the mix, temperature of the ambient air and wind speed during laying of the surface;~~

- ~~6.1.5. — Date when the surface was laid and contractor;~~
- ~~6.1.6. — All or at least the latest test result, including:~~
- ~~6.1.6.1. — The residual voids content of each core;~~
- ~~6.1.6.2. — The locations in the test area from where the cores for voids measurements have been taken;~~
- ~~6.1.6.3. — The sound absorption coefficient of each core (if measured). Specify the results both for each core and each frequency range as well as the overall average;~~
- ~~6.1.6.4. — The locations in the test area from where the cores for absorption measurement have been taken;~~
- ~~6.1.6.5. — Texture depth, including the number of tests and standard deviation;~~
- ~~6.1.6.6. — The institution responsible for tests according to paragraphs 6.1.6.1. and 6.1.6.2. and the type of equipment used;~~
- ~~6.1.6.7. — Date of the test(s) and date when the cores were taken from the test track.~~
- ~~6.2. — Documentation of vehicle noise tests conducted on the surface~~

~~In the document describing the vehicle noise test(s) it shall be stated whether all the requirements of this standard were fulfilled or not. Reference shall be given to a document according to paragraph 6.1. describing the results which verify this.~~

## Specifications for the noise test site

### 1. Introduction

This Annex describes the specifications relating to the physical characteristics and the laying of the noise test track. These specifications based on a special standard<sup>6</sup>, describe the required physical characteristics as well as the test methods for these characteristics.

The surface design given in this Annex:

- (a) produces consistent levels of tyre/road noise emission under a wide range of operating conditions;
- (b) including those appropriate to vehicle noise testing;
- (c) minimizes inter-site variation;
- (d) provides minor absorption of the vehicle noise sources;
- (e) is consistent with road-building practice.

### 2. Terms and definitions

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

#### 2.1. Sound absorption coefficient $\alpha$

<sup>6</sup> ISO 10844:2011.

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.

**2.2. Surface profile**

**2.2.1. 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).

**2.2.2. Irregularity**

Maximum distance of a surface from the measurement edge of the straight edge between two contact points of the straight edge when placed perpendicular to the surface.

NOTE: Pavement characteristics at longer wavelengths than 0.5 m are considered to be above that of texture and are referred to here as irregularity.

**2.2.2.1. Longitudinal irregularity**

Irregularity in the longitudinal axis of the track.

**2.2.2.2. Transversal irregularity**

Irregularity in the direction perpendicular to the axis of the track.

**2.2.3. Straight edge**

Device used for measuring the deviation from a plane.

**2.2.4. 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 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.

**2.2.5. 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.

**2.2.6. 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.

- 2.3. **Gradient and cross fall**
- 2.3.1. **Gradient**

Ratio of the height difference and the length measured along the longitudinal axis of the drive lane, expressed as a percentage.
- 2.3.2. **Cross fall**

Height difference expressed as a percentage of the length measured along the transversal axis of the drive lane.
- 2.4. **Propagation area**

Part of the test track on each side of the drive lane (see Figure 1).
- 2.5. **Drive lane**

Part of the test track where the vehicle runs.
- 2.6. **Stiffness**

Ratio of a normal force and resulting displacement.
- 2.7. **Dense asphalt concrete**

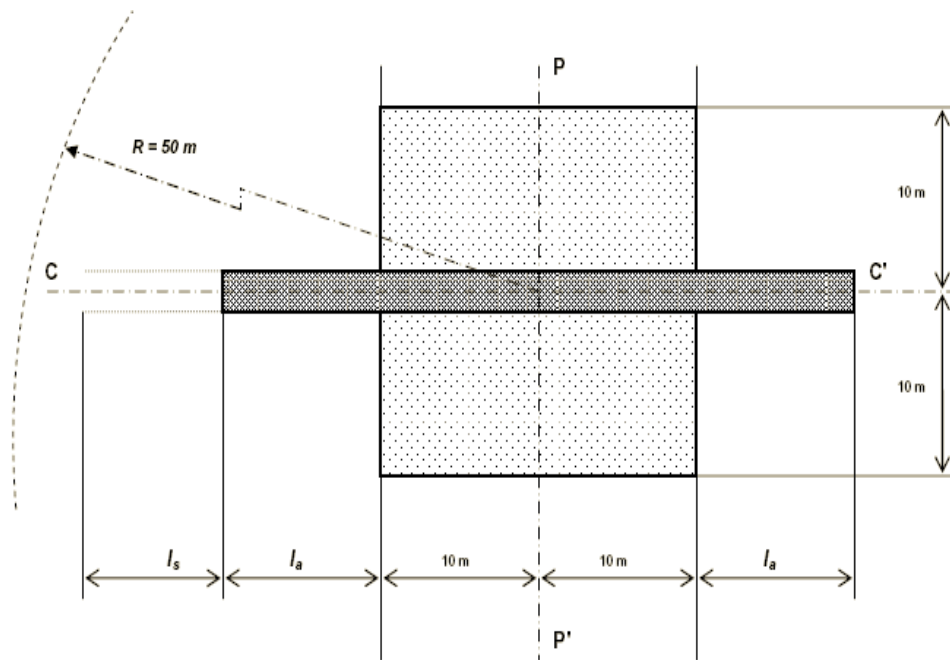
Asphalt in which the aggregate particles are essentially continuously graded to form an interlocking structure.
- 2.8. **Mean profile depth**

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.
- 3. **Requirements of the test track**

A surface is considered to conform to this standard if the following requirements have been met.
- 3.1. **Size and geometry**
- 3.1.1. **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.

Figure 1  
Size of the test track



**Key**

- $l_s$  construction run-up section
- $l_a$  drive lane extension beyond propagation area
- CC' drive lane centre line
- PP' microphone line
- Light shaded area propagation area
- Dark shaded area drive lane

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 testing tyres, passenger cars, motorcycles, light duty vehicles, trucks. For long vehicles with rear engine, having a distance of more than 10 m between reference point and the front axle
$l_a$	10 m	20 m <sup>a</sup>

<sup>a</sup> 20 m is necessary only for the exit side (BB') of 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'.

The space around the centre of the track within a radius of 50 m 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 noise reflection is focused on the test track.

### 3.1.2. Geometry

#### (a) Drive lane

The drive lane shall fulfil the following requirements:

- (i) 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;
- (ii) 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;
- (iii) For acceptance only, deviation from the horizontal plane in transverse direction of 1.0 per cent maximum (see Figure 2) and in a longitudinal direction of 0.5 per cent maximum.

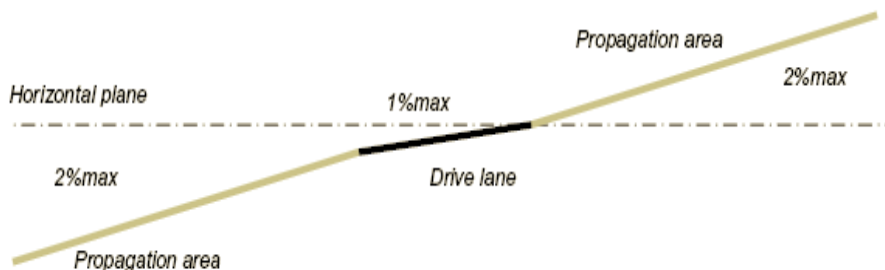
It is recommended that the irregularities requirements be fulfilled starting from the microphone line to cover the drive lane plus 10 m from the end of the section  $l_a$  on both sides.

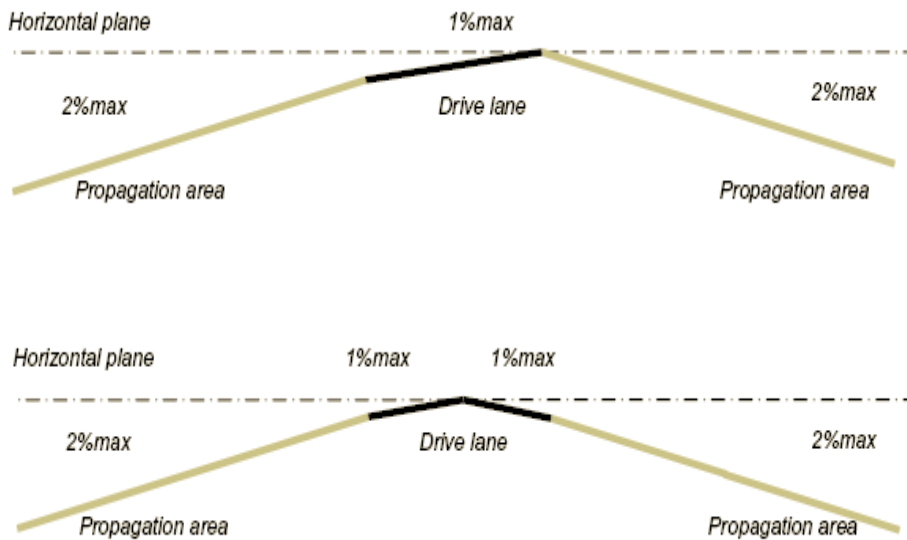
#### (b) Propagation area

- (i) The propagation area shall have irregularities equal to or less than 0.02 m measured with the straightedge according to EN 13036-7;
- (ii) 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 per cent (see Figure 2);

*Note:* The slope should be designed in such a way that water drainage is possible.

Figure 2  
Propagation area slope in transverse direction





**Key**

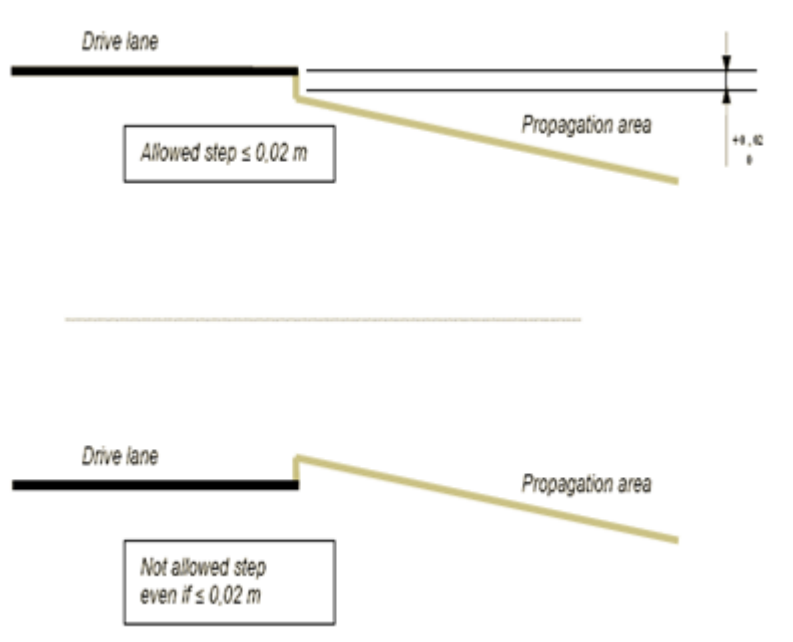
**1 per cent max: allowed drive lane cross fall**

**2 per cent max: allowed propagation area cross fall**

Steps or discontinuities between the propagation area and the drive lane shall be between 0 and +0.02 m. Negative steps are not allowed (see Figure 3).

**Figure 3**

**Propagation area – Steps or discontinuities**



### 3.2. 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 per cent. The sound absorption coefficient shall be measured according to 4.3.

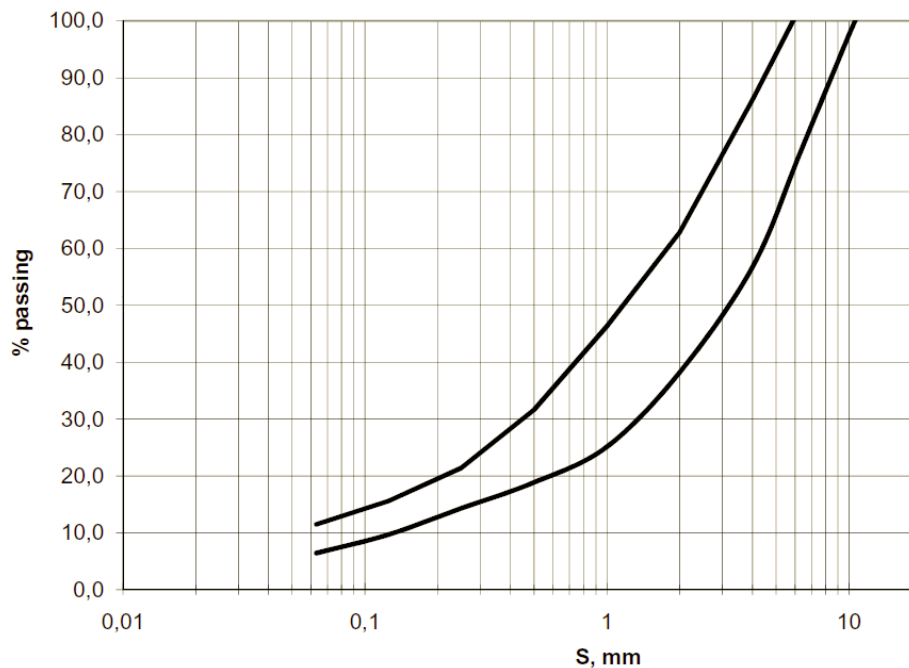
Location and number of measurement points are given in 3.4.

### 3.3. Surface properties of the drive lane

The surface of the drive lane shall:

- (a) be of dense asphalt concrete;
- (b) exhibit a sound absorption equal to or less than 8 per cent in any one-third-octave band between 315 Hz and 1 600 Hz when measured according to 4.3;
- (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 than or equal to 30 mm;
- (e) have a Mean Profile Depth measured according to ISO 13473-1 of  $0.5 \text{ mm} \pm 0.2 \text{ mm}$ ;
- (f) have a target sieving curve for the aggregate as shown in Figure 4.

**Figure 4**  
Sieving curve area

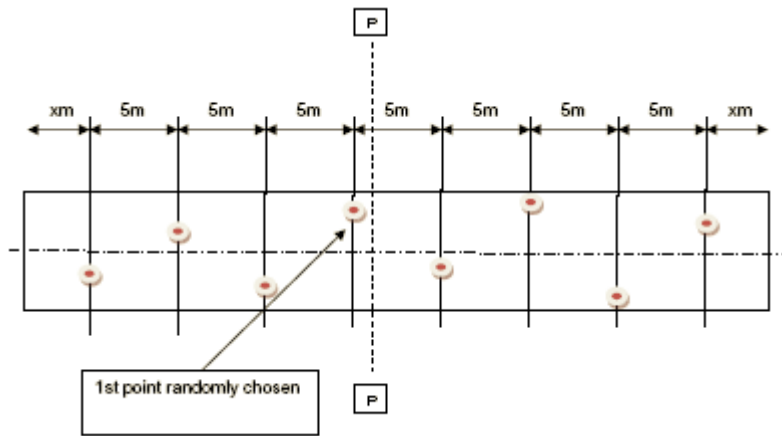


### 3.4. Conformity tests

- (a) The surface properties for each requirement shall be determined at the following measurements points 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 to Figure 5;
- (d) For sound absorption, texture, geometrical compliance, the first test 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.

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

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

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

	<i>For acceptance</i>		<i>For periodical checking</i>	
	Drive lane	Propagation area	Drive lane	Propagation area
<i>Requirements for the track</i>				
Gradient	×	N.A.	N.A.	N.A.
	(0.5 %)			
Slope				
Cross fall	×	×	N.A.	N.A.

<i>Requirements for the track</i>	<i>For acceptance</i>		<i>For periodical checking</i>	
	<b>Drive lane</b>	<b>Propagation area</b>	<b>Drive lane</b>	<b>Propagation area</b>
	<b>(1 %)</b>	<b>(2 %)</b>		
<b>Longitudinal irregularity</b>	× <b>(≤2 mm)</b>	× <b>(≤20 mm)</b> randomly	× <b>(≤5 mm)</b> <b>2 years<sup>a</sup></b>	<b>N.A.</b>
<b>Transverse irregularity</b>	× <b>(≤3 mm)</b>		× <b>(≤5 mm)</b> <b>2 years<sup>a</sup></b>	<b>N.A.</b>
<b>Texture</b>	× <b>MPD</b> <b>0.5mm ± 0.2mm</b>	<b>N.A.</b>	× <b>MPD</b> <b>0.5mm ± 0.2mm</b> <b>2 years<sup>a</sup></b>	<b>N.A.</b>
<b>Absorption</b>	× <b>(8 % max)</b>	× <b>(10 %max)</b>	× <b>(8 % max)</b> <b>4 years<sup>a</sup></b>	<b>N.A.</b>
<b>Grading curve</b>	×	<b>N.A.</b>	<b>N.A.</b>	<b>N.A.</b>

× : to be checked

N.A.: not applicable

<sup>a</sup> : Periodicity

### 3.5. 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 per cent of the samples shall meet the following requirements:

- (a) acoustic absorption;
- (b) surface texture;
- (c) geometrical compliance.

### 3.6. Stability with time and maintenance

The test track is a test instrument that should be taken care of and be protected from damage and be taken care of. The test track should only be used 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 3.2 and 3.3) of the test track are not affected.

**3.7. 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.

If the surface is exclusively used for testing heavy vehicles ( $M_2$  above 3,5 t,  $M_3$ ,  $N_2$  and  $N_3$ ) this break-in period is not necessary.

**4. Measurement methods and data processing**

**4.1. Irregularity measurement methods**

The irregularity of the drive lane shall be determined according to EN 13036-7 using a straight edge consisting of a beam of 3.0 m length and wedge with 1 mm steps on the oblique side.

**4.2. Texture measurements methods**

**4.2.1. Profile measurement**

The profile is measured according to ISO 13473-1 for Mean Profile Depth (MPD) and ISO 13473-3 for Expected Noise Due to Texture (ENDT). The measurement instrumentation shall meet the requirements of class DE defined in ISO 13473-3.

Additional details of 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 an 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 measured, each one at least 0.8 m long and positioned in a way which give statistically independent MPD values.

The MPD requirement in 3.3 shall be met at each of the eight locations or sections.

When calculating ENDT, the wavelength spectrum from 100 mm to 5 mm one-third-octave band of the profile shall be obtained according to the specifications of ISO/TS 13473-4. A tapered cosine window is preferred (refer to ISO 13472-4).

**4.2.2. Texture profile data pre-processing**

Removal of spike data is necessary. For details refer to ISO/TS 13473-6.

**4.3. Acoustic absorption measurement method**

The acoustic absorption shall be measured in the frequency range from 280 Hz to 1,800 Hz with an in-situ device meeting the specifications of



ISO 13472-2. The results shall be expressed in the one-third octave band coefficients according to the procedure described in ISO 13472-2.

5. **Conformity report**

The test report for each pavement test surface shall contain all information required for construction approval or periodical inspection, whichever is applicable.

Example:

(a) **General information**

- (i) **Owner;**
- (ii) **Contractor's name;**
- (iii) **Date of construction of the test track;**
- (iv) **Location of the test track;**
- (v) **Certifying authority (if applicable);**
- (vi) **Certification status;**
- (vii) **Main use of the test track (e.g. truck tyre coast by, testing, passenger car drive by);**
- (viii) **Notable features (e.g. under track, heating).**

(b) **Size and geometry**

(i) **Size:**

a. **Dimensions of the driving lane:**

- i. **Total length (m);**
- ii. **Width (m);**
- iii.  **$l_a$  (m);**
- iv.  **$l_s$  (m).**

b. **Dimensions of the propagation area:**

- i. **Length (m);**
- ii. **Width (m).**

c. **Free space.**

**Radius (m)**

**Notable feature**

(ii) **Geometry:**

a. **Drive lane:**

- i. **Transverse and longitudinal irregularities (m);**
- ii. **Deviation from the horizontal plane in transverse direction (per cent).**

b. **Propagation area:**

- i. **Irregularities (m);**

- ii. Slope in transverse direction (per cent);
        - iii. Steps or discontinuities (m).
  - (c) Surface properties:
    - (i) Material:
      - c. Drive lane:
        - i. Sound absorption;
        - ii. Maximum chipping size;
        - iii. Thickness of wearing course;
        - iv. Texture;
        - v. Sieving curve;
        - vi. Elastic material.
      - d. Propagation area; Sound absorption.
    - (ii) Homogeneity statement of surface properties.
  - (d) Proving the requirements:
    - (i) Scheme of the measuring point;
    - (ii) Measuring material description;
    - (iii) Description of the measuring methods.
  - (e) Homogeneity of surface properties.
- 6. Documentation of vehicle noise-tests conducted on the surface

**In the document describing the vehicle or tire noise test(s), it shall be stated whether all the requirements of this were fulfilled or not. Reference shall be given to a document according to which the results are verified."**

### III. Justification

1. The measuring equipment, including the noise test track, should meet the latest technical requirements. In 2011, ISO 10844:1994 was updated to ISO 10844:2011 to significantly reduce the site to site variation due to test track influence. The requirements on the noise test track should refer to ISO 10844:2011.
2. However, it is recognized that around 20 per cent of the existing noise test tracks may not meet the latest requirements. Rebuilding or repaving these noise test tracks requires a certain period of time and, therefore, a 2-year transitional period has been proposed.