



**SLOVENSKI STANDARD**  
**oSIST prEN ISO 13473-1:2017**  
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**Karakterizacija teksture vozišča z uporabo profilov površine - 1. del: Ugotavljanje povprečne globine profila (ISO/DIS 13473-1:2017)**

Characterization of pavement texture by use of surface profiles - Part 1: Determination of mean profile depth (ISO/DIS 13473-1:2017)

Charakterisierung der Textur von Fahrbahnbelägen unter Verwendung von Oberflächenprofilen - Teil 1: Bestimmung der mittleren Profiltiefe (ISO/DIS 13473-1:2017)

Caractérisation de la texture d'un revêtement de chaussée à partir de relevés de profils de la surface - Partie 1: Détermination de la profondeur moyenne du profil (ISO/DIS 13473-1:2017)

**Ta slovenski standard je istoveten z: prEN ISO 13473-1**

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**ICS:**

17.140.30	Emisija hrupa transportnih sredstev	Noise emitted by means of transport
93.080.20	Materiali za gradnjo cest	Road construction materials

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## Characterization of pavement texture by use of surface profiles —

### Part 1: Determination of mean profile depth

*Caractérisation de la texture d'un revêtement de chaussée à partir de relevés de profils de la surface —  
Partie 1: Détermination de la profondeur moyenne du profil*

ICS: 17.140.30; 93.080.20

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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](http://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](http://www.iso.org/patents)).

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For an explanation on 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 the following URL: [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html).

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

This second edition cancels and replaces the first edition (ISO 13473-1:1997), which has been technically revised. <https://standards.iteh.ai/catalog/standards/sist/f3e4b62b-2332-4db2-8071-46de6d8a6a87/sist-en-iso-13473-1-2019>

A list of all parts in the ISO 13473- series can be found on the ISO website.

## ISO/DIS 13473-1:2017(E)

### Introduction

Road surface texture determines factors such as noise emission from the tyre/pavement interface, acoustic comfort inside vehicles, friction between the tyre and road, rolling resistance and tyre wear. Valid methods for measuring surface texture are therefore highly desirable.

The so-called 'sand patch' method, or the more general 'volumetric patch' method (see [Clause 3, Definitions](#)) has been used worldwide for many years to give a single and very simple measurement describing surface texture. It relies on a given volume of sand or glass beads which is spread out on a surface. The material is distributed to form a circular patch, the diameter of which is measured. By dividing the volume of material spread out by the area covered, a value is obtained which represents the average depth of the sand or glass bead layer, i.e. a 'Mean Texture Depth'. The method was originally standardized in Annex A of ISO 10844:2014<sup>[25]</sup> in order to put limits concerning surface texture for a reference surface used for vehicle noise testing but was later adopted by CEN as EN 13036-1.

The volumetric patch method is operator-dependent and can be used only on surfaces which are partly or fully closed to traffic. Therefore, it is not practical for use in network surveys of roads, for example. Along with developments in contactless surface profiling techniques, it has become possible to replace the volumetric patch measurements with those derived from profile recordings, which are possible to make by mobile equipment in flowing traffic. However, several very different techniques have been used to calculate a 'predicted mean texture depth', many of them quite successfully. The values they give are not always comparable, although individually they generally offer good correlation coefficients with texture depth measured with the volumetric patch method.

It is, therefore, important to have a standardized method for measuring and evaluating the texture depth by a more modern, safe and economical technique than the traditional volumetric patch method, resulting in values which are directly compatible both with the patch-measured values and between different equipment.

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# Characterization of pavement texture by use of surface profiles —

## Part 1: Determination of mean profile depth

### 1 Scope

This part of ISO 13473 describes a test method to determine the average depth of pavement surface macrotexture (see [Clause 3](#), Definitions) by measuring the profile of a surface and calculating the texture depth from this profile. The technique is designed to provide an average depth value of only the pavement macrotexture and is considered insensitive to pavement microtexture and unevenness characteristics.

The objective of this part of ISO 13473 is to make available an internationally accepted procedure for determination of pavement surface texture depth which is an alternative to the traditionally used volumetric patch technique (generally using sand or glass beads), giving comparable texture depth values.

Modern profilometers in use are almost entirely of the contactless type (e.g. laser or light slit to mention a few) and this standard is intended for this type. However, a contact-type of profilometer may use applicable parts of this standard.

This ISO 13473- series has been prepared as a result of a need identified when specifying a test surface for vehicle noise measurement (ISO 10844). Macrotexture depth measurements according to this International Standard are not generally adequate for specifying test conditions of vehicle or traffic noise measurements, but have limited applications as a supplement in conjunction with other ways of specifying a surfacing.

This test method is suitable for determining the Mean Profile Depth of a pavement surface. This Mean Profile Depth can be transformed to a quantity which estimates the macrotexture depth according to the volumetric patch method. It is applicable to field tests as well as laboratory tests on pavement samples. When used in conjunction with other physical tests, the macrotexture depth values derived from this test method are applicable to estimation of pavement skid resistance characteristics (see e.g. reference<sup>[1]</sup> in the Bibliography), estimation of noise characteristics, and assessment of the suitability of paving materials or pavement finishing techniques.

The method, together with other measurements (where applicable), such as porosity or microtexture, can be used to assess the quality of pavements.

This part of ISO 13473 is adapted for pavement texture measurement and is not intended for other applications. Pavement aggregate particle shape, size, and distribution are surface texture features not addressed in this procedure. The method is not meant to provide a complete assessment of pavement surface texture characteristics. In particular, care should be exercised in interpreting the result if the method is applied to porous surfaces or to grooved surfaces (see [Annex B](#)).

**NOTE** Other International Standards dealing with surface profiling methods include for example ISO 468 [2], ISO 1878 [3], ISO 1879 [4], ISO 1880 [5], ISO 3274 [6], ISO 4287 [7][8] and ISO 4288 [9] (see the Bibliography). Although it is not clearly stated in these, they are mainly used for measuring surface finish (microtexture) of metal surfaces and were not intended to be applied to pavements.

## ISO/DIS 13473-1:2017(E)

### 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/TS 13473-6, *Verification procedure for the performance of contactless profilometers*

ISO/IEC Guide 98-3, *Uncertainty of measurement — Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)*

### 3 Terms and definitions

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

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

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

#### 3.1 texture wavelength

$\lambda$

quantity describing the horizontal dimension of the irregularities of a texture profile

Note 1 to entry: Texture wavelength is normally expressed in metres (m) or millimetres (mm).

#### 3.2 texture

pavement texture

deviation of a pavement surface from a true planar surface, with a texture wavelength less than 0,5 m

#### 3.3 surface profile

texture profile

upper contour of a vertical cross-section through a pavement

Note 1 to entry: Texture profile is similar to surface profile but limited to the texture range.

Note 2 to entry: The profile of the surface is described by two coordinates: one in the surface plane, called **distance** (the abscissa), and the other in a direction normal to the surface plane, called **vertical displacement** (the ordinate). An example is illustrated in [Figure A.1](#). The distance may be in the longitudinal or lateral (transverse) directions in relation to the travel direction on a pavement, or in a circle or any other direction between these extremes.

Note 3 to entry: “Texture wavelength” is a descriptor of the wavelength components of the profile and is related to the concept of the Fourier Transform of a series regularly sampled measurement points along a spatial axis. It should also be noted that vertical displacement (height) has an arbitrary reference.

#### 3.4 macrotexture

pavement 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

Note 1 to entry: 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.

Note 2 to entry: Based on physical relations between texture and friction/noise, etc., the World Road Association (PIARC), originally defined the ranges of micro-, macro- and megatexture [10]. [Figure A.2](#), which is a modified version of the original PIARC figure, illustrates how these definitions cover certain ranges of surface texture wavelength and spatial frequency. Note that ride discomfort includes effects experienced in and on motorised road vehicles and bicycles, as well as wheelchairs and other vehicles used by disabled people.

### 3.5 Texture depth measurements

#### 3.5.1

##### Texture Depth

*TD*

in the three-dimensional case, the distance between the surface and a plane through the top of the three highest peaks within a surface area in the same order of a size as that of a car tyre/pavement interface

Note 1 to entry: See [Figure A.3](#).

#### 3.5.2

##### Mean Texture Depth

*MTD*

texture depth obtained from the volumetric patch method

Note 1 to entry: In the application of the 'volumetric patch method' (see below) the 'plane' is in practice determined by the contact between a rubber pad and the surface when the pad is rubbed over the area. Therefore, the texture depth obtained in this case is not based on exactly a 'plane', but rather an approximation which is a somewhat curved surface which is hard to define.

#### 3.5.3

##### Profile Depth

*PD*

in the two-dimensional case; i.e. when studying a profile, the difference, within a certain longitudinal/lateral distance in the same order of length as that of a car tyre/pavement contact interface, between the profile and a horizontal line through the top of the highest peak within this profile

Note 1 to entry: See [Figure A.4](#).

#### 3.5.4

##### evaluation length

*l*

length of a portion of a profile for which *MPD* is to be calculated

#### 3.5.5

##### reporting length

length of a pavement for which *MPD* is to be reported either as a single value for the entire length or for a sequence of smaller sections

#### 3.5.6

##### segment

portion of the profile over a length of 100 mm

Note 1 to entry: See [Figure A.4](#).

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### 3.5.7

#### Mean Segment Depth

*MSD*

average value of the profile depth of a segment

Note 1 to entry: See [Figure A.4](#).

### 3.5.8

#### Mean Profile Depth

*MPD*

average of the values of the Mean Segment Depth (*MSD*) of the tested section

### 3.5.9

#### Estimated Texture Depth

*ETD*

term used when the Mean Profile Depth (*MPD*) is used to estimate the Mean Texture Depth (*MTD*) by means of a transformation equation

### 3.6

#### volumetric patch method

method relying on the spreading of a material, usually sand or graded glass beads, in a patch

Note 1 to entry: The material is distributed with a rubber pad to form an approximately circular patch, the average diameter of which is measured. By dividing the volume of material by the area covered, a value is obtained which represents the average depth of the layer, i.e. a 'Mean Texture Depth'. The volumetric patch method is described in EN 13036-1.

Note 2 to entry: The volumetric patch method is used not only with sand or glass beads as the patch material, but in some cases with putty or grease. However, such materials have certain disadvantages, and for international standardization only glass beads have been recommended. The *ETD* measure is based on glass beads as the patch material.

### 3.7

#### drop-out

data in the measured profile indicated by the sensor as invalid

### 3.8

#### spike

unusually high and sharply defined peak in the measured profile, which is not part of the true profile, and which is not automatically detected as invalid by the system

Note 1 to entry: See [Annex E](#) for a quantitative definition of a spike.

## 4 Test surfaces

### 4.1 Condition of the surface

Measurements shall not be made during rain or snow fall. Unless it has been demonstrated that the equipment provides valid measurements on wet or damp surfaces, the surface shall be dry during the measurements. It shall also be clean and reasonably free of debris and foreign objects.

NOTE 1 Optical-based measuring systems may not perform properly on newly laid asphalt surfaces which are glossy and dark. If the test is performed during the paving process, optical distortions due to temperature gradients in the air above the tested surface may produce invalid data.

NOTE 2 For roads which have been in service, the texture may vary across the pavement. In this case, the transverse location of the measurement will normally be determined by the intended use of the data.

## 4.2 Amount of data to be collected per field test section

### 4.2.1 Continuous measurements

Continuous measurements are made when a certain length of a road is measured with possible interruptions of a maximum of 10 % of the length. The minimum evaluation length over which *MPD* is calculated shall be 1,0 metre. It is not meaningful to report *MPD* over shorter lengths.

It is recommended that measurements and calculations be made continuously along the entire test section.

### 4.2.2 Spot measurements

If a continuous measurement is not possible, as is the case for stationary devices, one may make measurements at certain spots which are appropriately distributed. The following minimum requirements apply:

- Each evaluation length shall include at least eight single measured segments of at least 100 mm length. This would normally be along a straight line, but may also be in a circular path or in parallel lines (in connection with 3D measurements). Each segment shall be measured continuously. The exception is when analysing round laboratory samples; see 4.3.
- The procedure in [Annex C](#) is recommended to select measurement positions and evaluation lengths in an unbiased manner.

For surfaces with periodic textures (e.g. grooved or tined surfaces), the total profile length shall include at least 10 periods of the dominant texture frequency.

## 4.3 Amount of data to be collected on laboratory samples

Laboratory samples are generally either circular cores or rectangular slabs. They may be directly taken from a road or airfield, produced in a laboratory or replicated based on mouldings from an actual road or airfield site.

When measuring laboratory samples, care should be taken that edge effects of the samples do not affect the measurement.

In order for the measurements to give values reasonably representative of an actual field site, the following two requirements shall be met:

- Cores, slabs or mouldings intended for profile measurement shall be taken from at least four different places, evenly distributed longitudinally along the site.
- The measurements shall include at least 4 profiles (in total), evenly distributed on the laboratory samples (see below); each profile measured over at least 100 mm length and not being part of another profile, except that one profile can cross another profile.

It is recommended that cores have a minimum 150 mm diameter, although 100 mm diameter cores are acceptable. If the core diameter does not allow measurements to follow a straight line of the required length across the core, it is recommended to rotate the core underneath the sensor (or vice versa) and make the measurement along a circle around the core centre. Such circles should have a minimum 50 mm diameter.

Rectangular samples often have dimensions which exceed typical core dimensions. On such samples one should distribute individual profile measurements uniformly.

**NOTE** Measurements on laboratory samples may have many different purposes. This means that it is difficult to specify general minimum requirements. The specification here assumes that the purpose is to obtain values which are reasonably representative of pavements.

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### 5 Measurement instruments

#### 5.1 Instruments in general

A profilometer system shall be used which produces a signal output that is proportional to the distance between a sensor reference plane and the surface spot in question. Examples of sensors include acoustical, electro-optical type, or a video camera. The final output shall be linearly related to the texture profile and this may be obtained either in hardware or software, as necessary. The profilometer system shall also provide means of moving the sensor along or across the surface at an elevation (vertically) which is essentially constant over at least one profile length. This does not apply when the profile is produced by some techniques such as light sectioning.

The performance of profilometers used for this application shall be verified in accordance with the procedure described in ISO/TS 13473-6.

#### 5.2 Vertical resolution

The vertical resolution shall be 0,05 mm or better. The measuring range of the sensor should be a minimum of 20 mm. When measuring smoother surfaces, a smaller range is permissible. For a sensor mounted on a moving vehicle, a higher range is usually required to allow for vehicle motion.

NOTE A laser sensor system having a measuring range of 200 mm and a 12-bit digital resolution will have a vertical resolution of a little less than 0,05 mm.

#### 5.3 Horizontal resolution

In the case of a device utilizing a laser, other electro-optical sensor, or a sensor based on sound transmission, the spot of the radiation should be such that its average diameter on the road surface shall in no case be greater than 1 mm over the used vertical range. In this case, the effective spot is taken as that contained within an area limited by a contour line where the intensity of the spot is  $1/e$  (approximately 37 %) of the maximum intensity within the spot.

In the case where a light-sectioning device is used, the projected light band or line shall be sufficiently sharp to give a light/dark transition within 1 mm. In this case, the effective line width is taken as that where the intensity of the line has reduced from 100 % to  $1/e$  (approximately 37 %) of the maximum intensity within the line.

In the case where a contact device is used (e.g. utilizing a stylus sensor), the widest dimension of the contacting part (tip) shall have a diameter of no more than 1 mm up to 1 mm in height from the tip. Contact forces on the surface shall not be so high as to cause penetration or destruction of the surface texture. Such destruction is usually detectable as a clearly visible trace where contact was made.

The sampling interval shall not be more than 1,0 mm.

NOTE It shall be noted that the movement by the laser or light spot during the time of collecting each sample means that the spot is extended somewhat in the direction of measurement. This "stretching" of the spot due to the measurement speed can be calculated by dividing the measurement speed by the time for each sample collection and it should never result in a spot longer than 1 mm. It may mean a limitation of the measurement speed.

#### 5.4 Horizontal accuracy

The maximum permissible error for the determination of the segment length (see [7.7](#)) shall be 10 mm.

## 5.5 Measurement speed

The measurement speed is the speed with which the profile is traced by the profilometer, and shall be such that the requirements on sampling interval are met. This applies to stationary as well as mobile profilometers. The relation is:

$$v \leq f_s \cdot s / 1000 \quad (1)$$

where

$v$  = profilometer speed (m/s);

$f_s$  = sampling frequency of the sensor (1/s);

$s$  = sampling interval ( $\leq 1,0$  mm).

In some devices the speed influences the effect of the background noise, since the latter may be higher at higher frequencies. Depending on how sampling takes place and the low-pass filtering, the speed may influence the electronic frequency corresponding to the lower texture wavelength limit. See [5.2](#) regarding possible effect of sampling variations.

NOTE Low-pass refers to a filtering of the signal with the intention to attenuate the higher frequencies (either temporal or spatial).

## 5.6 Alignment of sensor

In case of reflected radiation, the angle between the optical or acoustical axis of the radiation toward the surface and the optical or acoustical axis of the detector ( $\alpha$ ) shall not exceed  $30^\circ$ . See [Figure 1](#). Larger angles will underestimate very deep textures and cause higher drop-out rates. This paragraph applies also to light-sectioning devices.

For mechanical devices,  $\alpha$  is not applicable and  $\beta$  shall be no more than  $30^\circ$ .