BS EN 10049:2013

BSI Standards Publication

Measurement of roughness average *Ra* and peak count *RPc* on metallic flat products

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National foreword

This British Standard is the UK implementation of EN 10049:2013. It supersedes BS EN 10049:2005 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee ISE/109, Coated and Uncoated Flat Products to be Used for Cold Forming.

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

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EN 10049

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English Version

Measurement of roughness average Ra and peak count RPc on metallic flat products

Mesure de la rugosité moyenne Ra et du nombre de pics RPc sur les produits plats métalliques

Messung des arithmetischen Mittenrauwertes Ra und der Spitzenzahl RPc an metallischen Flacherzeugnissen

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Foreword

This document (EN 10049:2013) has been prepared by Technical Committee ECISS/TC 109 “Flat products for cold working - Qualities, dimensions, tolerances and specific tests”, the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by May 2014, and conflicting national standards shall be withdrawn at the latest by May 2014.

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

This document supersedes EN 10049:2005.

The whole document was technically revised.

The European Committee for Iron and Steel Standardization (ECISS) has given Technical Committee 109 (Secretariat France) the task to prepare a European Standard on the measuring of roughness as a revision of EN 10049:2005.

The reason for the existence of this European Standard is that general roughness measurement rules as described in ISO standards (see Clause 2) are not practical for metallic flat products for the following reasons:

- the practical use of EN ISO 4288 is not convenient for flat products, because the choice of the cut-off (λc) is dependent on the Ra to be measured; the product range is quite wide and the transition point for Ra is 2 μm in EN ISO 4288 (EN ISO stipulates a cut-off (λc) of 0,8 mm for Ra < 2μm and a cut-off (λc) of 2,5 mm for Ra > 2μm);

- in the automotive industry, the use of a cut-off (λc) of 2,5 mm is based on requirements related to paint appearance.

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

1 Scope

This European Standard defines the measurement conditions for surface roughness parameters of metallic flat products, both uncoated (cold and hot rolled pickled steel) and coated with metallic coatings (e.g. zinc, aluminium, tin, chromium) (see 3.1).

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN ISO 5436-1, *Geometrical Product Specifications (GPS) — Surface texture: Profile method; Measurement standards — Part 1: Material measures (ISO 5436-1)*

EN ISO 16610-21, *Geometrical product specifications (GPS) — Filtration — Part 21: Linear profile filters: Gaussian filters (ISO 16610-21)*

3 Terms and definitions

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

3.1
application group products

3.1.1
application group 1 product
metallic flat product mainly used in the automotive industry, uncoated or coated with metallic coatings (e.g. zinc, aluminium)

3.1.2
application group 2 product
metallic flat product mainly used for applications other than those of the automotive industry (e.g. tinplate or chromium coated steel for packaging, uncoated or coated cold rolled steel, pickled hot rolled steel)

3.2
surface profile
profile that results from the intersection of the real surface by a specified plane

Note 1 to entry: See EN ISO 4287.

3.3
primary profile (P-profile)
digital form of the surface profile after sampling and applying a profile filter λs to suppress very short wavelength components due to noise and vibrations

Note 1 to entry: The measuring device is a stylus instrument conforming to EN ISO 3274 or an optical roughness measurement system.

Note 2 to entry: The profile filter λs is referred to in EN ISO 16610-21.

3.4
roughness profile (R-profile)
profile derived from the primary profile by suppressing the long wave components, using the profile filter λc

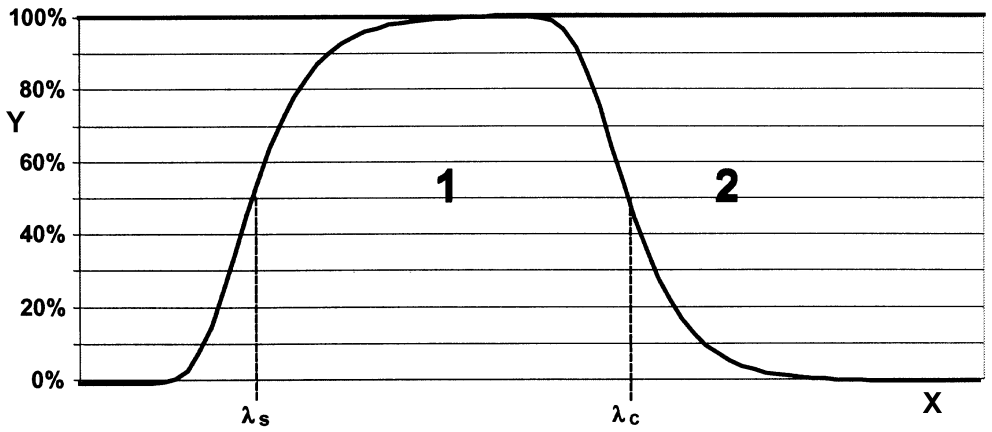
Note 1 to entry: See EN ISO 3274 and EN ISO 16610-21.

3.5
λc profile filter
filter determining the intersection between the roughness and waviness components

3.6
λs profile filter
filter determining the intersection between the roughness and the even shorter wave components present in a surface

3.7
transmission band
range of wavelengths between the profile filters λs and λc

Note 1 to entry: The transmission characteristic is shown in Figure 1.



Key

X-axis	wavelength (logarithmic scale)
Y-axis	transmission ratio
1	roughness
2	waviness

Figure 1 — Transmission characteristic

3.8
centre line of the roughness profile
centre line of the roughness profile separating the enclosed area of the roughness profile into two equal areas below and above this line

Note 1 to entry: See EN ISO 16610-21.

3.9
evaluation length *lm*
length in the direction of the X-axis used for assessing the profile under evaluation

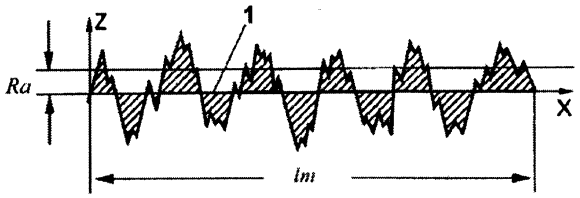
3.10
travel length *lt*
length in the direction of the X-axis physically used by the instrument

Note 1 to entry: Some instruments may require a travel length lt longer than the evaluation length *lm* because of start and end effects.

3.11
roughness average *Ra*
arithmetic mean of the absolute ordinates values *Z(x)* of the roughness profile

Note 1 to entry: *Ra* is expressed in micrometer.

Note 2 to entry: A schematic representation of *Ra* is given in Figure 2.



Key

1 centre line

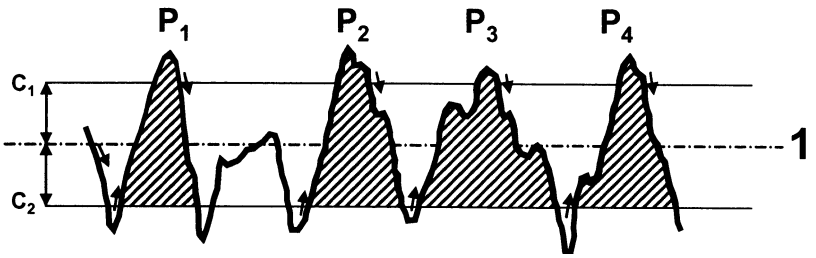
Figure 2 — Schematic representation of the roughness average *Ra*

3.12
peak count *RPc*
number of profile peaks over the full evaluation length *lm*

Note 1 to entry: *RPc* is expressed as an absolute number per cm.

Note 2 to entry: For the purpose of this standard, the height discrimination is performed by consecutively intersecting a lower section line c_2 (in upwards direction) and an upper section line c_1 (in downwards direction). See Figure 3.

Note 3 to entry: For the purpose of this standard, *RPc* is calculated over the full evaluation length *lm*.



Key

1 centre line

Figure 3 — Peak count *RPc*

3.13
surface types

3.13.1
stochastic surface
surface not showing a lateral pattern

Note 1 to entry: Stochastic surfaces can be generated by mill rolls obtained e.g. by grinding, Shot Blast Texturing (SBT), Electro Discharge Texturing (EDT), Electro Chemical Deposition (ECD), some types of Electron Beam Texturing (EBT), chemical processes (e.g. pickling).

Note 2 to entry: Isotropic surface is a synonym of stochastic surface.

3.13.2
non-stochastic surface
surface showing a typical lateral pattern

Note 1 to entry: Non-stochastic surfaces can be generated by mill rolls obtained e.g. by Laser Texturing (LT) and Electron Beam Texturing (EBT).

Note 2 to entry: A lateral pattern is clearly observable by using a simple optical magnifier, with e.g. a magnification x 30.

Note 3 to entry: Non-isotropic surface is a synonym of non-stochastic surface.

4 Measuring instrument

4.1 General

The instrument to use is either a stylus instrument conforming to EN ISO 3274 or an optical roughness measurement system. The device is generally composed of a measuring head, a traverse unit and an evaluation device. When using an optical roughness measurement system the calibration shall assure that the measured values are aligned with the reference stylus method values.

All the following subclauses are related to measurements performed using the stylus instrument. For such an instrument, the measuring head is usually called pick-up system.

4.2 Pick-up system

The datum system is the reference system for the roughness measurement (see Figure 4).

A double-skid system is used for practical measurements (see Figure 5). The skid dimensions are as follows:

— *Rs,x*: 50 mm;

— *Rs,y*: 3 mm;

— SA: 4.5 mm;

— AB: 13 mm.

By mutual agreement, a single skid system can also be used (see Figure 6).

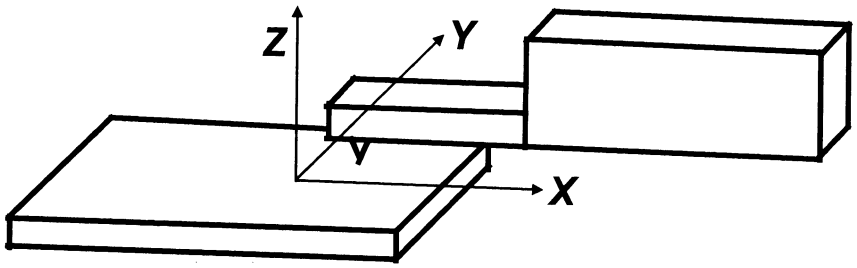
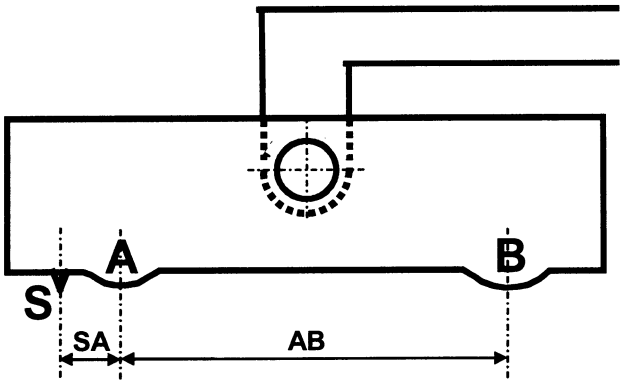


Figure 4 — Datum system (either table or pick-up moving)



Key

S position of the stylus tip

A, B positions of the skids with the following radii:

— *Rs,x* : skid radius in the x direction;

— *Rs,y* : skid radius in the y direction.

SA horizontal distance between the stylus tip and the centre of the first skid

AB horizontal distance between the centres of the skids

Figure 5 — Double-skid system

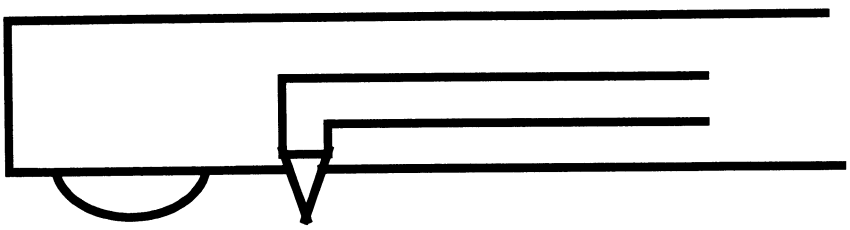
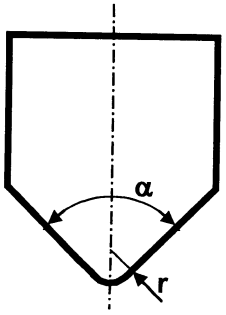


Figure 6 — Example of one type of single skid system

The stylus has a cone shape with a cone angle α and a tip radius r with the following values:

— α : 90 (+5 / -10)°;

— r : 5 ± 1 µm.



Key

α	cone angle
r	tip radius

Figure 7 — Stylus tip

4.3 Evaluation profile filter

According to EN ISO 16610-21, a gaussian filter is used to separate roughness and waviness (see Figure 1).

4.4 Checking of the measuring instrument

The error-free functioning of the whole measuring system shall be regularly checked by means of a suitable calibrated roughness standard specimen of type D according to EN ISO 5436-1 (see Figure 8 and Figure 9).

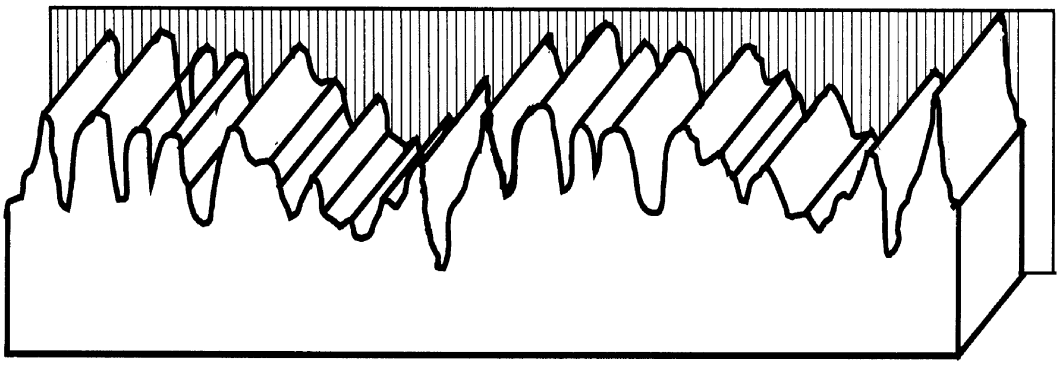


Figure 8 — Example of roughness standard specimen of type D (EN ISO 5436-1)

Dimensions in millimetres

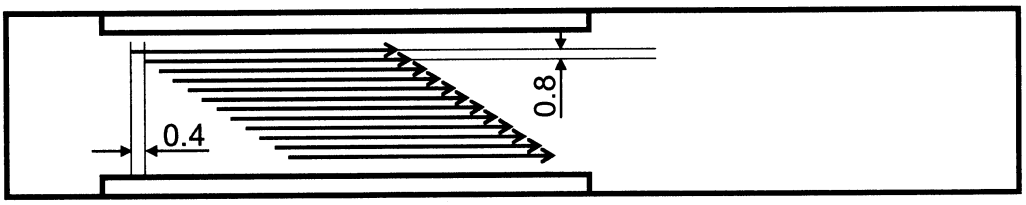


Figure 9 — Measuring plan for the calibration

5 Sample preparation

Samples shall be flat, i.e. the maximum bend degree should not exceed 4 mm over a length of 200 mm. They shall be clean and free from any features or other defects that may disturb the roughness measurement. They shall be degreased before measurement. The samples for measurement shall be taken at least at 40 mm from the edge of the surface to be checked.

6 Measuring conditions

6.1 General

Measurements on the surface to be checked shall be performed using the following conditions (see Table 1).

Table 1 — Measuring conditions

Field of application	Unit	Application group 1[a]	Application group 2[a]
Cut-off λc	mm	2,5	0,8[b]
Section line c_1	µm	+ 0,5	[c]
Section line c_2	µm	- 0,5	[c]
Transmission band $\lambda c/\lambda s$	-	300/1	300/1
Evaluation length l_m	mm	5 λc	5 λc
Maximum sampling spacing	µm	1,6	0,5
Maximum measuring force	mN	1	1
Maximum measuring speed	mm/sec	1	1
Measuring direction for stochastic surfaces	-	The recommended direction is perpendicular to the rolling direction.	
Measuring direction for non-stochastic (or non-isotropic) surfaces	-	The measuring direction should be different from the principle direction of the texturing process, but can vary as agreed on between parties. EXAMPLE A hexagonal pattern has 30° or 60° as principal directions, depending on the position of the hexagon relative to the rolling direction. In this case a measuring direction of 45° ± 5° is recommended.	
Number of measurements for averaging over the surface	-	Minimum 3[c]	
Specification	-	Ra and RPc By exception Ra[c]	Ra or (Ra and RPc)[c]

[a] For the definitions, see 3.1.

[b] For certain specific applications, it may be necessary to use a different λc.

[c] To be agreed between parties and included in the test report.

6.2 Disputes

In case of dispute:

— the number of individual measurements shall be agreed on between parties (recommendations can be found in EN ISO 4288);

— a datum based stylus instrument shall be used in order to avoid any distortion still present in the double-skid system;

— a reference standard of the specimen of type D according to EN ISO 5436-1 (see Figure 8) shall be used for the checking of the instruments.

7 Test report

The test report shall refer to this European Standard and mention at least the following data:

— type of measuring head;

— cut-off λc;

— measuring direction;

— arithmetic mean value of Ra;

— arithmetic mean value of RPc (if required);

— all the measuring conditions differing from those specified in Table 1.

Bibliography

[1] EN ISO 4287, *Geometrical product specifications (GPS) — Surface texture: Profile method — Terms, definitions and surface texture parameters (ISO 4287)*

[2] EN ISO 4288, *Geometrical product specifications (GPS) — Surface texture: Profile method — Rules and procedures for the assessment of surface texture (ISO 4288)*

[3] EN ISO 5436-2, *Geometrical product specifications (GPS) — Surface texture: Profile method; Measurement standards — Part 2: Software measurement standards (ISO 5436-2)*

[4] EN ISO 3274, *Geometrical product specifications (GPS) — Surface texture: Profile method — Nominal characteristics of contact (stylus) instruments (ISO 3274)*

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