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**Paints and varnishes — Evaluation of  
properties of coating systems related  
to the spray application process —**

Part 2:

**Colour stability, process hiding power,  
re-dissolving, overspray absorption,  
wetting, surface texture and mottling**

*Peintures et vernis — Évaluation des propriétés des systèmes de  
revêtement liés au mode d'application par pulvérisation —*

*Partie 2: Stabilité des couleurs, pouvoir masquant du procédé,  
détrempe, absorption des pertes de peinture à la pulvérisation,  
mouillage, texture superficielle et marbrures*



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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)).

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](http://www.iso.org/iso/foreword.html).

This document was prepared by Technical Committee ISO/TC 35, *Paints and varnishes*, Subcommittee SC 9, *General test methods for paints and varnishes*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 139, *Paints and varnishes*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 28199-2:2009), which has been technically revised.

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

- the assessment of mottling (see [10.2](#)) has been divided into measuring techniques and visual evaluation;
- limit values have been introduced for long-wavelength and short-wavelength surface textures (see [9.2.1](#));
- the normative references have been updated;
- the document has been editorially revised.

A list of all parts in the ISO 28199 series can be found on the ISO website.

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](http://www.iso.org/members.html).

## Introduction

In many areas (e.g. car manufacture, industrial coatings, coatings for plastics) the coating materials used are adapted to the specific application equipment and technologies of the particular user. A coating material is, therefore, to be understood as a semi-manufactured product that only receives its final form in combination with the specific application conditions. The adaptation to the application conditions is therefore decisive for the quality of the coated product.

The test methods specified in the ISO 28199 series are based on studies by a Working Group of the European Council for Automotive R&D (EUCAR).

They may be used for evaluation of coating materials in research, development and production with regard to their suitability and safety for industrial processes, and error analysis. The properties of coating materials and coatings to be evaluated depend on the film thickness, so a coating system of increasing thickness is applied to a test panel under defined conditions.

The following characteristics are measured (see ISO 28199-1):

- film thickness in accordance with ISO 2808;
- surface texture;
- colour in accordance with ISO 18314-1;
- mottling;
- gloss in accordance with ISO 2813.

In combination with visual assessment, the following properties are determined:

- colour stability, process hiding power, re-dissolving, overspray absorption, wetting, surface texture and mottling (this document);
- tendency to sagging, formation of bubbles, pinholing and hiding power (see ISO 28199-3).

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# Paints and varnishes — Evaluation of properties of coating systems related to the spray application process —

## Part 2:

# Colour stability, process hiding power, re-dissolving, overspray absorption, wetting, surface texture and mottling

## 1 Scope

This document specifies methods for the determination of colour stability/colour evaluation, process hiding power, re-dissolving, overspray absorption, wetting, surface texture and mottling of coating materials applied to a test panel under defined conditions, using spray application process.

## 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 28199-1:2021, *Paints and varnishes — Evaluation of properties of coating systems related to the spray application process — Part 1: Vocabulary and preparation of test panels*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 28199-1 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 <http://www.electropedia.org/>

## 4 Colour stability/colour evaluation

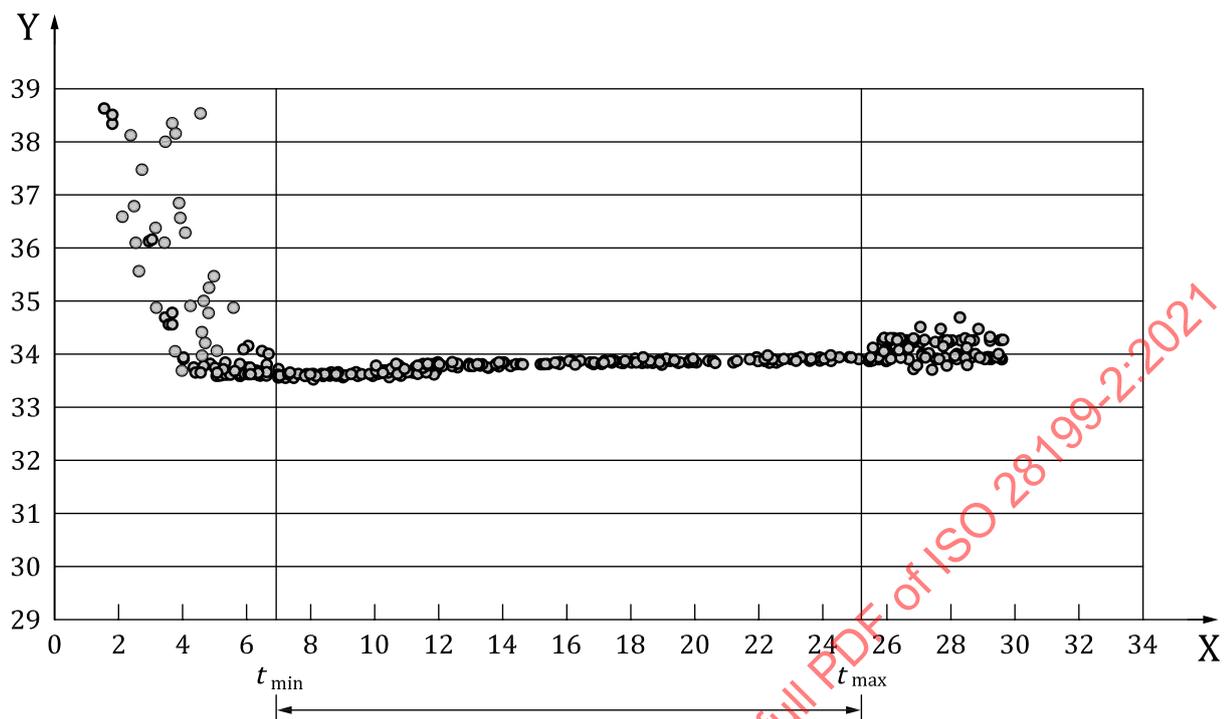
### 4.1 General

Colour stability is determined by evaluation of the values measured for a wedge-shaped base coat and constant-thickness clear coat, obtained in accordance with ISO 28199-1:2021, 9.4.

### 4.2 Evaluation

Plot the colour space values determined for the wedge-shaped base coat and constant-thickness clear coat in accordance with ISO 28199-1:2021, 9.4, against the film thickness of the base coat, and evaluate the curve. Determine the lowest ( $t_{\min}$ ) and the highest ( $t_{\max}$ ) film thicknesses at which the curve is approximately parallel to the X-axis. With regard to parallelism, a tolerance range or a minimum gradient is agreed. [Figures 1](#) and [2](#) show examples of lightness ( $L^*$ ) plotted against film thickness. The Y-axis can also show the colour values  $a^*$ ,  $b^*$ ,  $C^*$  and  $h$ .

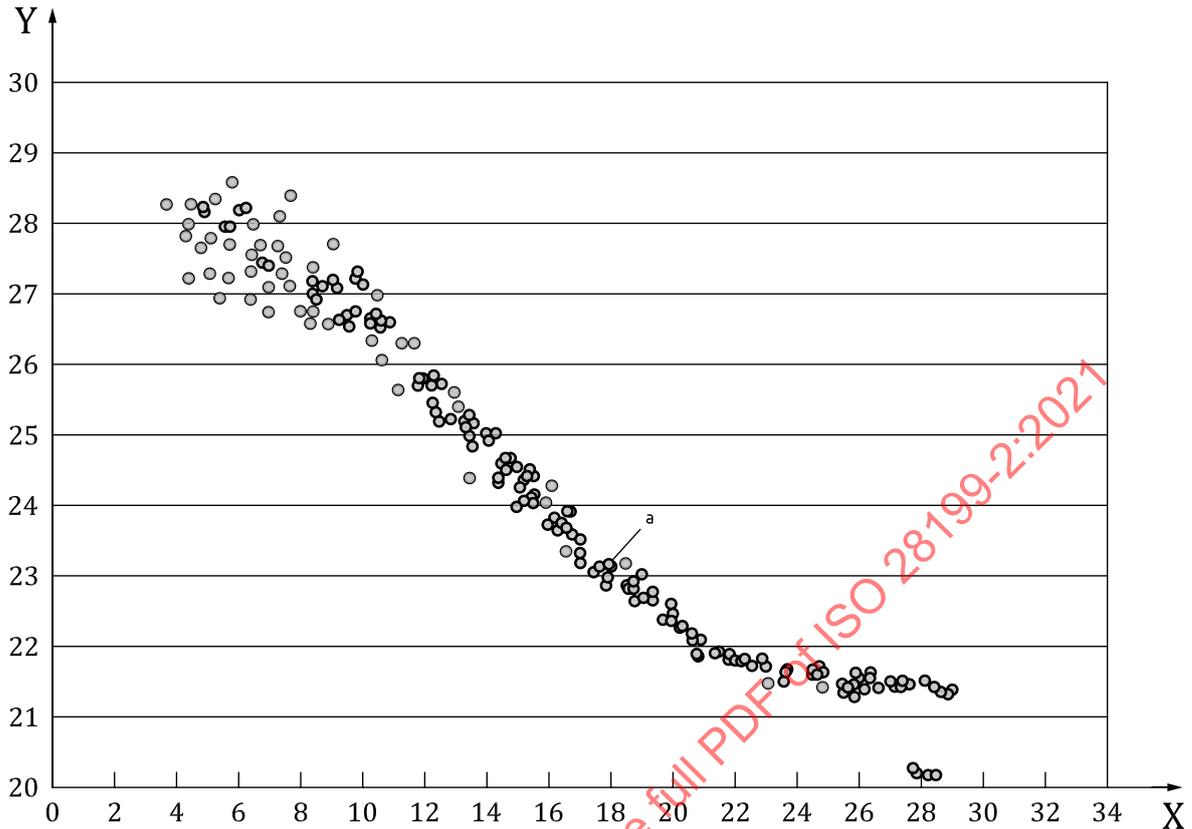
The range of colour stability ends at that film thickness at which the curve is no longer parallel to the X-axis.



**Key**

- X film thickness ( $\mu\text{m}$ )
- Y lightness
- $t_{\min}$  start of colour stability
- $t_{\max}$  end of colour stability

**Figure 1 — Graph showing colour stability (idealized)**

**Key**

X film thickness (μm)

Y lightness

a Drift in the colour values of the base coat indicates poor colour stability, for example.

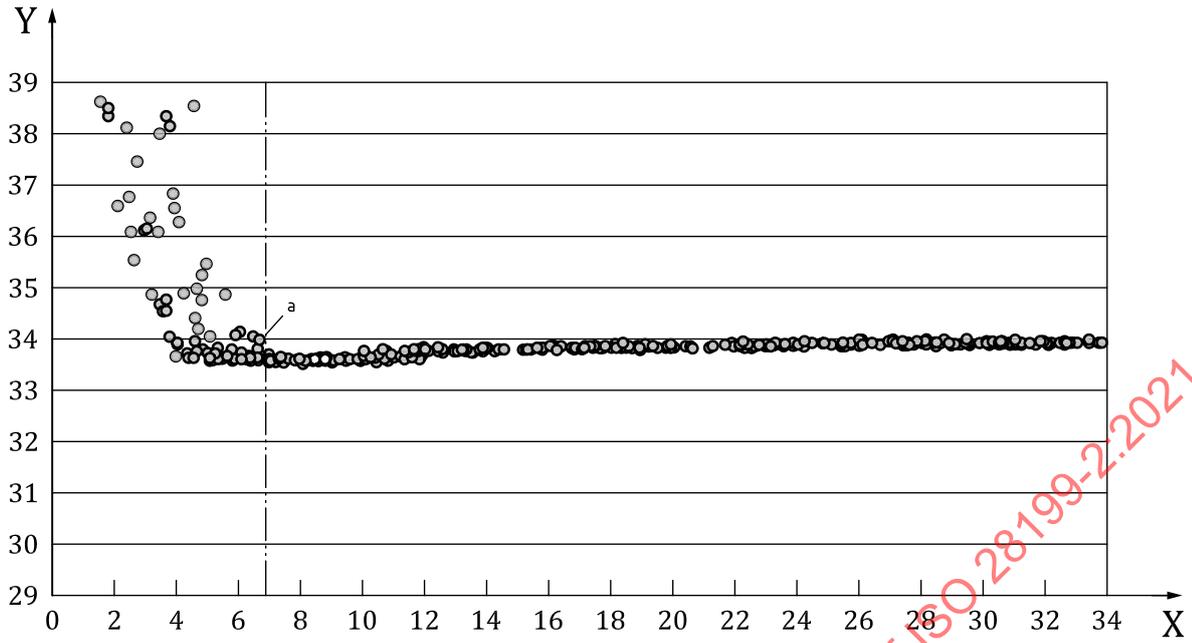
**Figure 2.— Graph showing lack of colour stability****5 Process hiding power****5.1 General**

The process hiding power is determined by evaluation of the values measured for the process substrate, wedge-shaped base coat and constant-thickness clear coat, obtained in accordance with ISO 28199-1:2021, 9.4. The lowest film thickness exhibiting colour stability ( $t_{\min}$ ) (see 4.2) is determined.

**5.2 Evaluation**

Using the same method for evaluating the colour stability as specified in 4.2, evaluate the values measured for the process substrate, wedge-shaped base coat and constant-thickness clear coat, obtained in accordance with ISO 28199-1. Figure 3 shows an example of lightness ( $L^*$ ) plotted against film thickness.

NOTE Often the behaviours of the curves resemble those for colour stability evaluation, but shifted into other film thickness ranges.



**Key**

X film thickness ( $\mu\text{m}$ )

Y lightness

<sup>a</sup> Point at which a constant colour value is achieved, i.e. the base coat covers the substrate used.

**Figure 3 — Process hiding power**

**6 Re-dissolving**

**6.1 General**

Re-dissolving is determined by evaluation of the values measured for the constant-thickness base coat and applied wedge-shaped clear coat, obtained in accordance with ISO 28199-1:2021, 9.4.

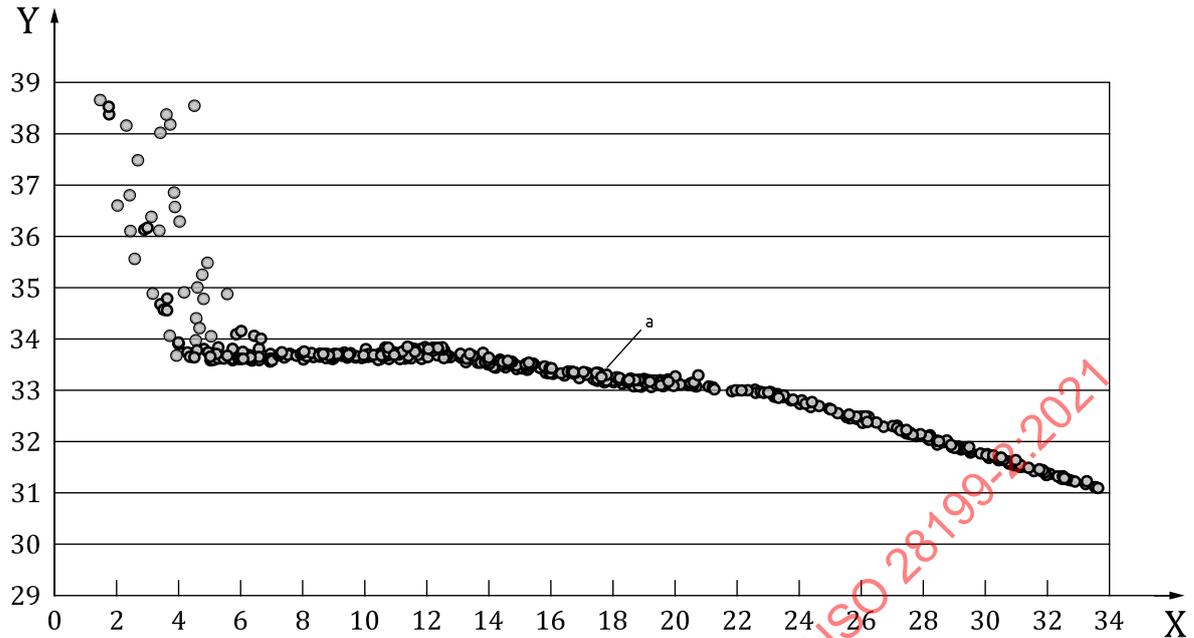
For a given drying/application process it is possible that, above a certain film thickness, insufficient solvent escapes. The top layer of the base coat will interact with the solvents of the clear coating material, which is applied later. This could lead to another arrangement of, for example, effect pigments, which can result in greater local differences of the colour space values at the same film thickness.

**6.2 Evaluation**

Plot the colour space values determined for the constant-thickness base coat and applied wedge-shaped clear coat, obtained in accordance with ISO 28199-1:2021, 9.4, against the film thickness of the clear coat. Visually evaluate the behaviour of the curves obtained, giving preference to  $L^*25^\circ$  and  $b^*25^\circ$ , since the effect is best visible at  $25^\circ$ . [Figure 4](#) shows an example of lightness ( $L^*$ ) plotted against film thickness.

Re-dissolving will be evidenced on the curve because, as film thickness increases, the curve will begin to drift out of the range defined for colour stability (end of the plateau for colour stability).

NOTE Assessment of re-dissolving can be carried out as a relative comparison between different clear coats.



#### Key

X film thickness ( $\mu\text{m}$ )

Y lightness

a Drift in colour values indicates re-dissolving.

Figure 4 — Re-dissolving

## 7 Overspray absorption

### 7.1 General

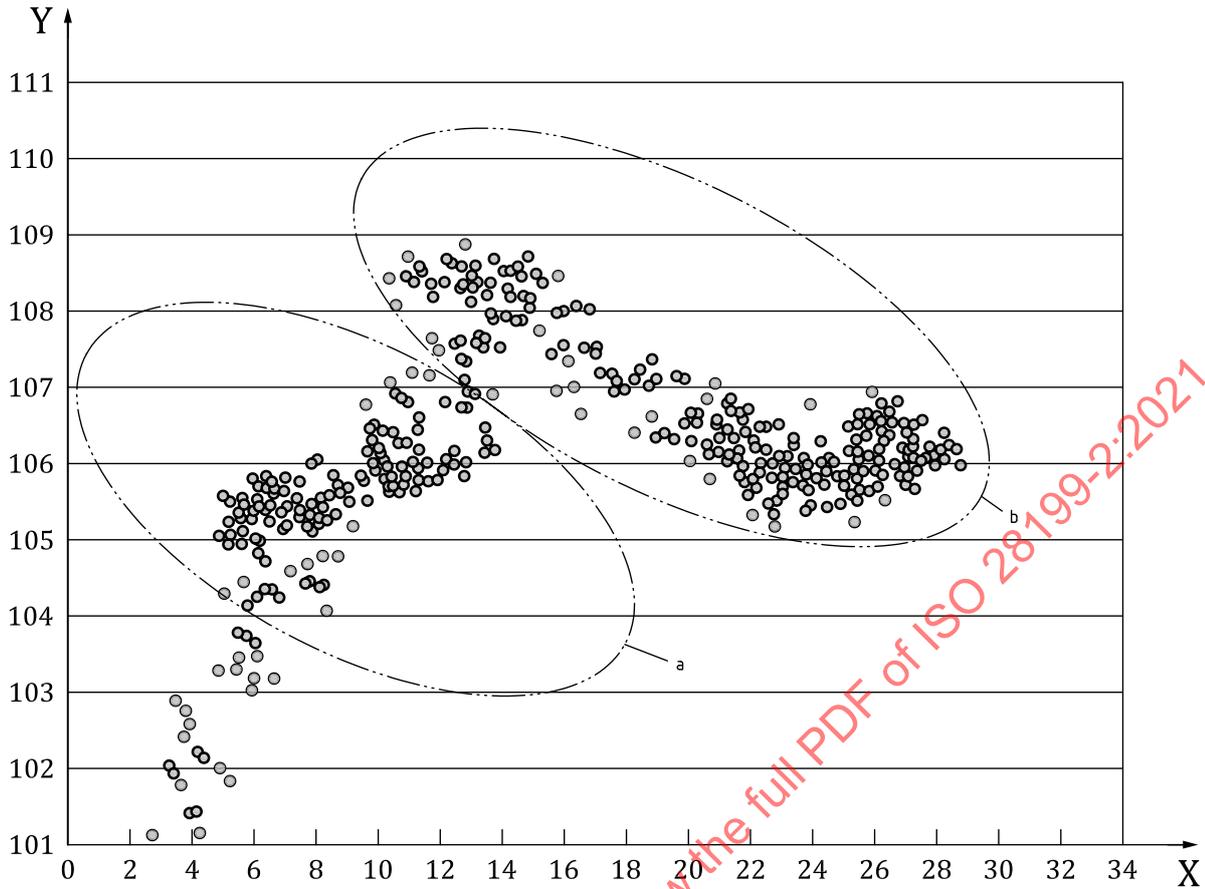
Overspray absorption is determined by evaluation of the values measured for the wedge-shaped base coat that was applied (twice) and for the constant-thickness clear coat, obtained in accordance with ISO 28199-1:2021, 9.4.

### 7.2 Evaluation

Using the values measured for the applied wedge-shaped base coat and constant-thickness clear coat, obtained in accordance with ISO 28199-1:2021, 9.4, plot the lightness value  $L^*_{25}$  (see ISO 18314-1) against the film thickness of the base coat. Figure 5 shows an example of lightness ( $L^*$ ) plotted against film thickness.

Good overspray absorption occurs when the first and second spraying stages merge with each other. This results in a steady transition from the plateau of the colour stability to the re-dissolving range (see Figure 5).

Insufficient overspray absorption is characterized by a large number of measured points occurring in at least two areas.



- Key**
- X film thickness (μm)
  - Y lightness
  - a Large number of measured points from first spraying stage.
  - b Large number of measured points from second spraying stage.

**Figure 5 — Insufficient overspray absorption**

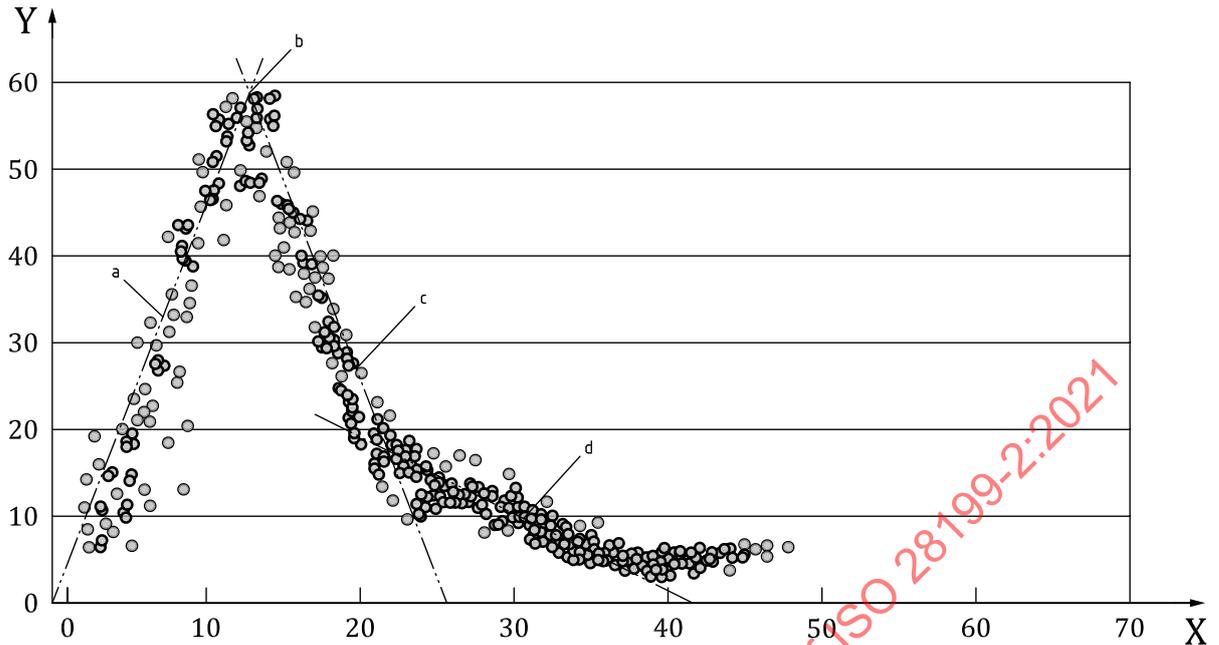
## 8 Wetting

### 8.1 General

Wetting is determined by evaluation of the values measured for the constant-thickness base coat and wedge-shaped clear coat, obtained in accordance with ISO 28199-1:2021, 9.4.

### 8.2 Evaluation

Using the values measured for the constant-thickness base coat and wedge-shaped clear coat, obtained in accordance with ISO 28199-1:2021, 9.4, plot the values for the long-wavelength ( $\geq 3$  mm) surface texture values against the film thickness, and determine the film thickness of the first wetting. [Figure 6](#) shows an example of long-wavelength values plotted against film thickness.



### Key

- X film thickness ( $\mu\text{m}$ )
- Y long-wavelength values
- a Beginning of wetting.
- b Substrate completely wetted.
- c Beginning of levelling.
- d Coating completely level.

Figure 6 — Wetting

## 9 Surface texture

### 9.1 General

The surface texture is determined by evaluation of the values measured for the wedge-shaped coating, obtained in accordance with ISO 28199-1:2021, 9.4.4.

### 9.2 Evaluation

#### 9.2.1 General evaluation

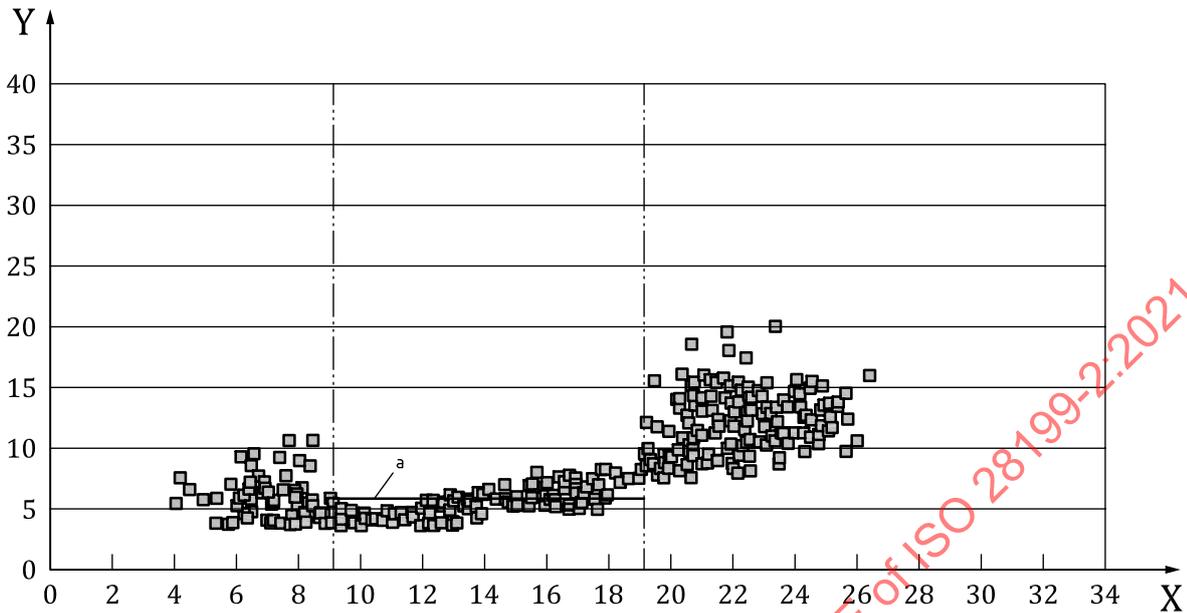
Using the values measured for the wedge-shaped coating, obtained in accordance with ISO 28199-1:2021, 9.4.4, plot the surface texture values against the film thickness. Figures 7 and 8 show examples of short-wavelength ( $<3$  mm) and long-wavelength ( $\geq 3$  mm) surface texture values plotted against film thickness.

#### 9.2.2 Evaluation of base coats

For evaluation of the base coat surface texture, use the short-wavelength values. Take the mean values of the short-wavelength values lying within the range permitted for the paint-application process in question (the so-called process window).

It shall be ensured that the short-wavelength values of the base coat within the process window are not distorted with the short-wavelength values of the clear coat.

The short-wavelength values of reference strip 2 (see ISO 28199-1:2021, Figure 2) shall be significantly less than the short-wavelength values of the measuring range.



**Key**

X film thickness ( $\mu\text{m}$ )

Y short-wavelength values

a Mean value of the short-wavelength values within the process window.

**Figure 7 — Surface texture of base coat**

**9.2.3 Evaluation of clear coats**

For the evaluation of clear coat surface texture, use the long-wavelength values. Calculate the mean value of the long-wavelength values within the process window.