INTERNATIONAL STANDARD

ISO 28199-2

Second edition
2021-06

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 liées 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

Reference number
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Foreword

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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).

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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.

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).

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

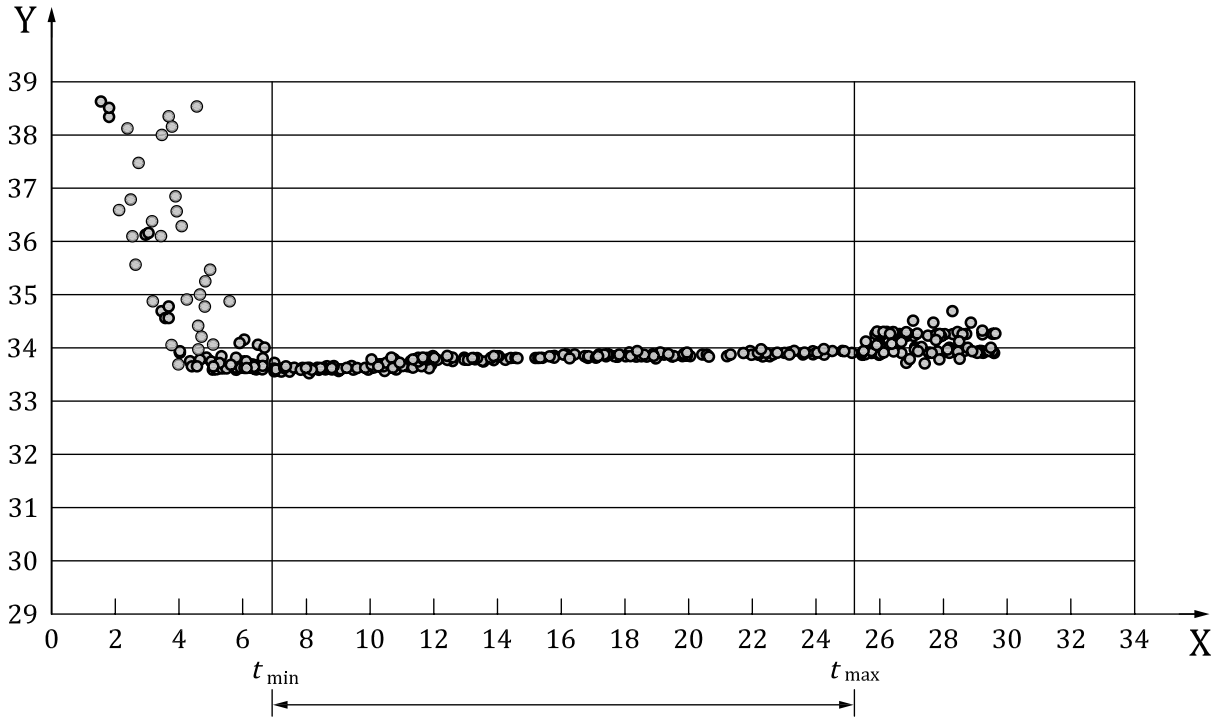
4.1 General

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

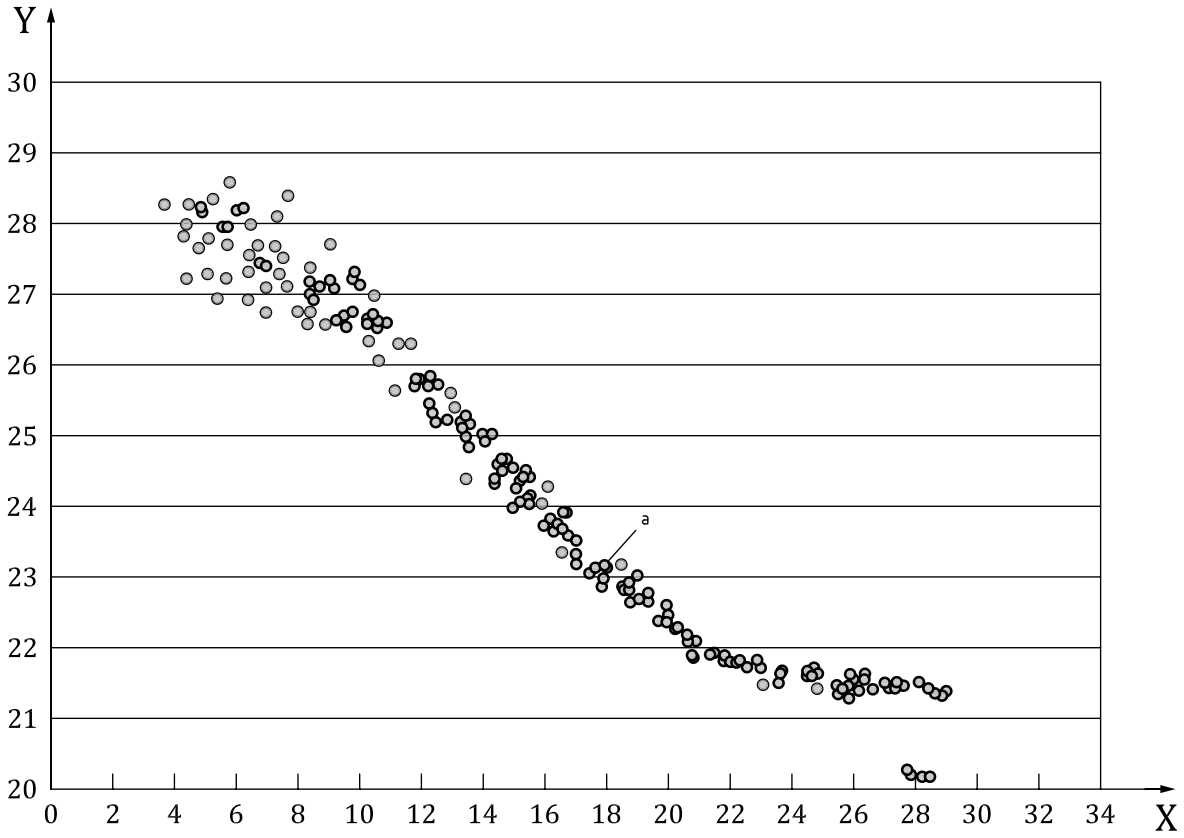
X film thickness (µm)

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

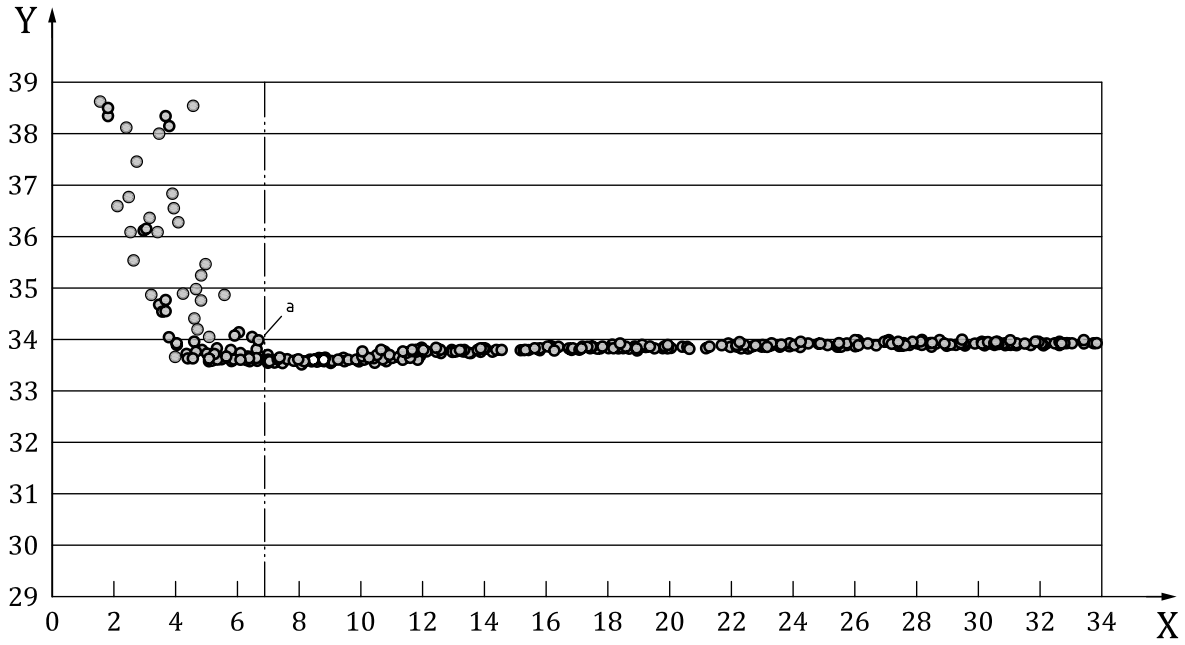
5.1 General

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 (µm)

Y lightness

a 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.

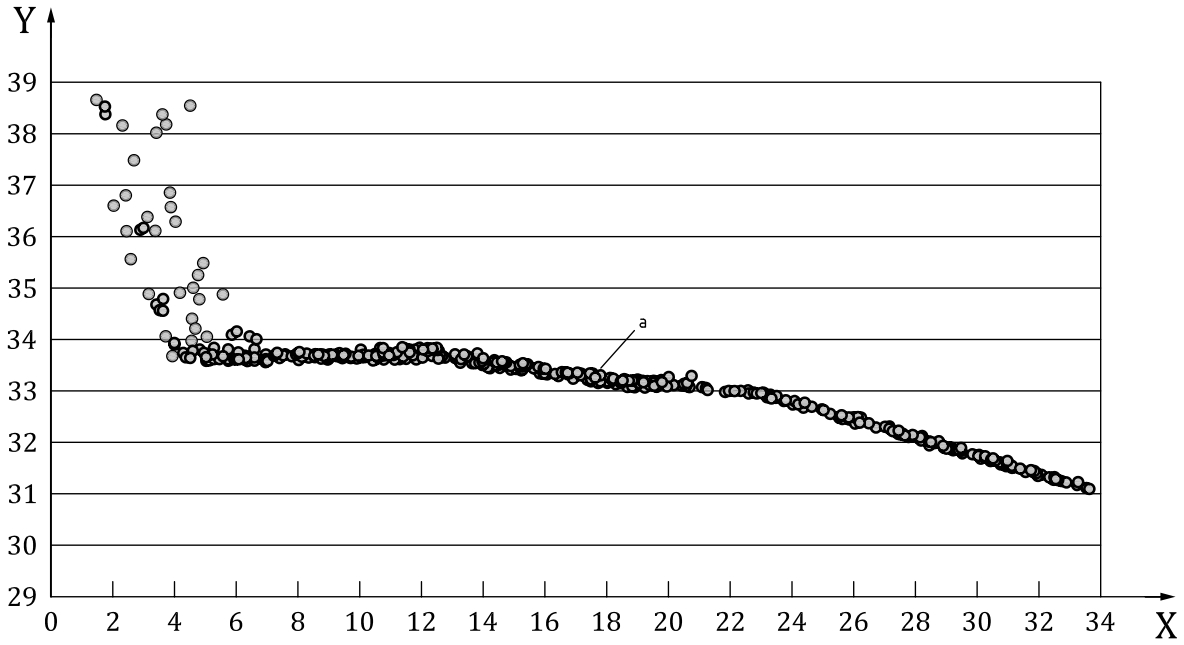
For a given drying/application process it is possible that, above a certain film thickness, insufficient solvent escapes. The top layer of the base coat will interact with the solvents of the clear coating material, which is applied later. This could lead to another arrangement of, for example, effect 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 $L^*25°$ and $b^*25°$, since the effect is best visible at 25°. 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 (µm)

Y lightness

[a] Drift in colour values indicates re-dissolving.

Figure 4 — Re-dissolving

7 Overspray absorption

7.1 General

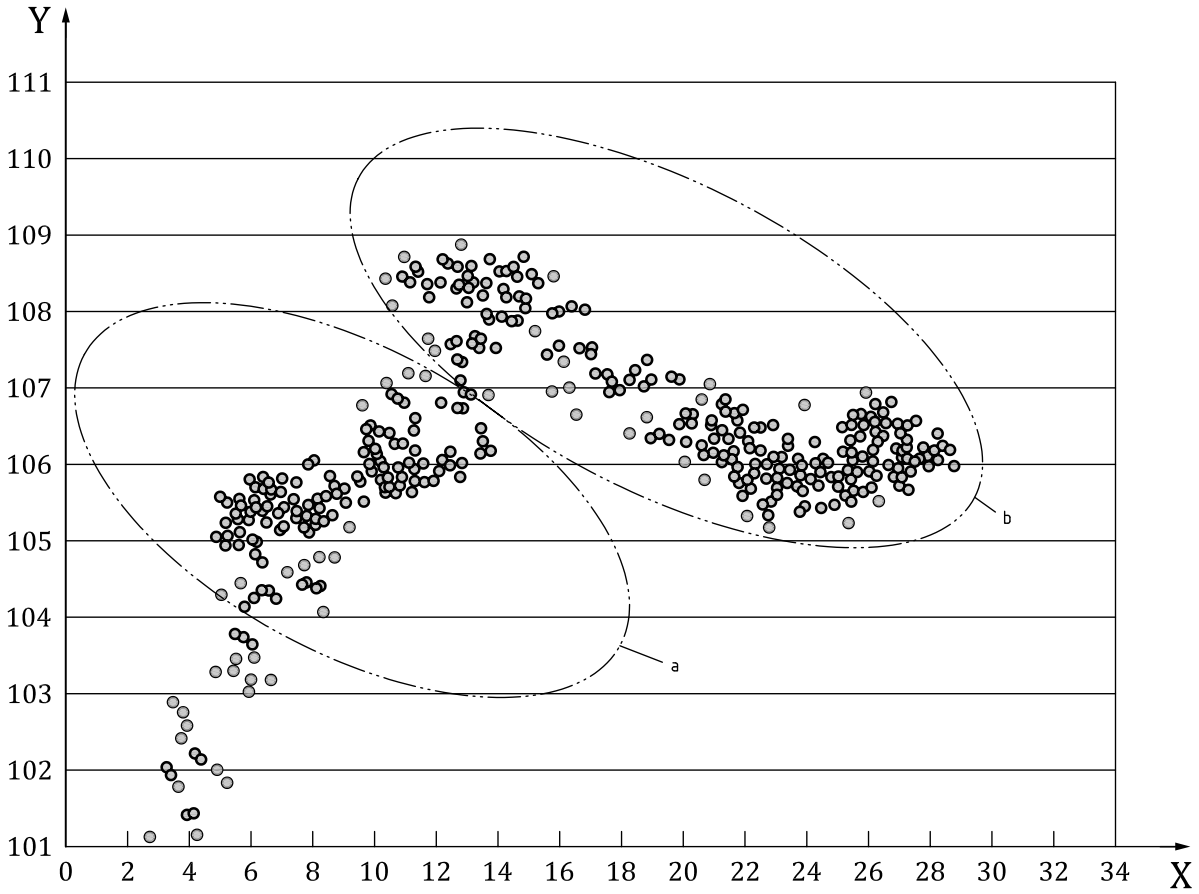
Overspray absorption is determined by evaluation of the values measured for the wedge-shaped base coat that was applied (twice) and for the constant-thickness clear coat, obtained in accordance with ISO 28199-1:2021, 9.4.

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

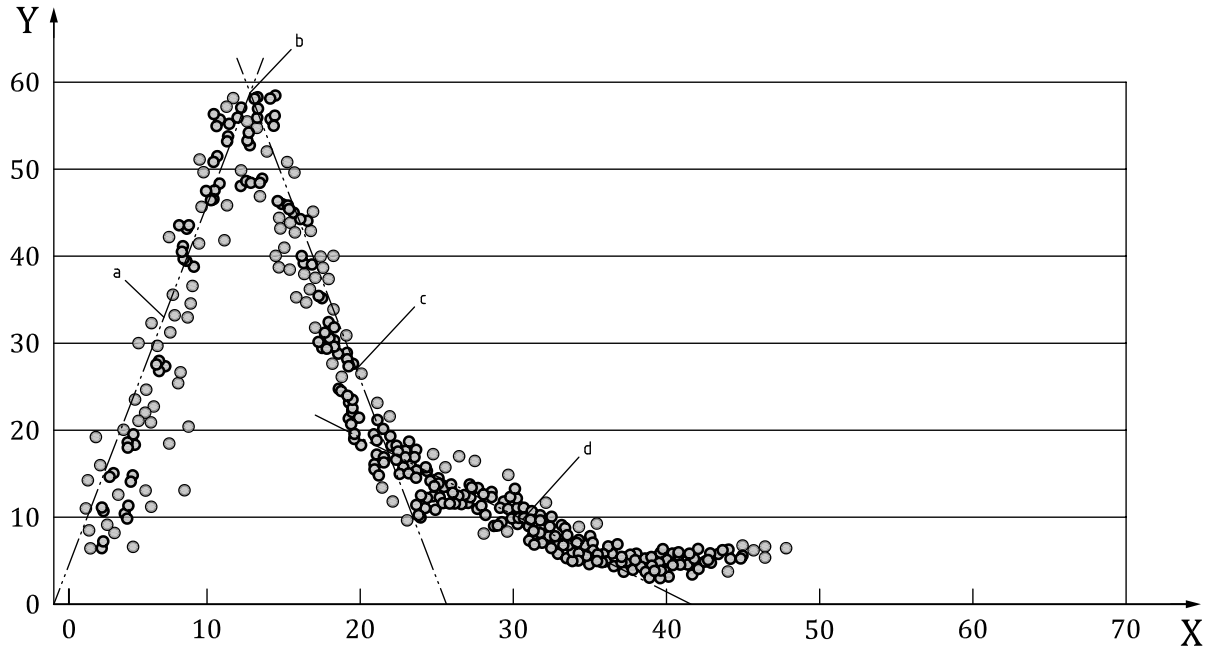
8 Wetting

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 (≥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 (µm)

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

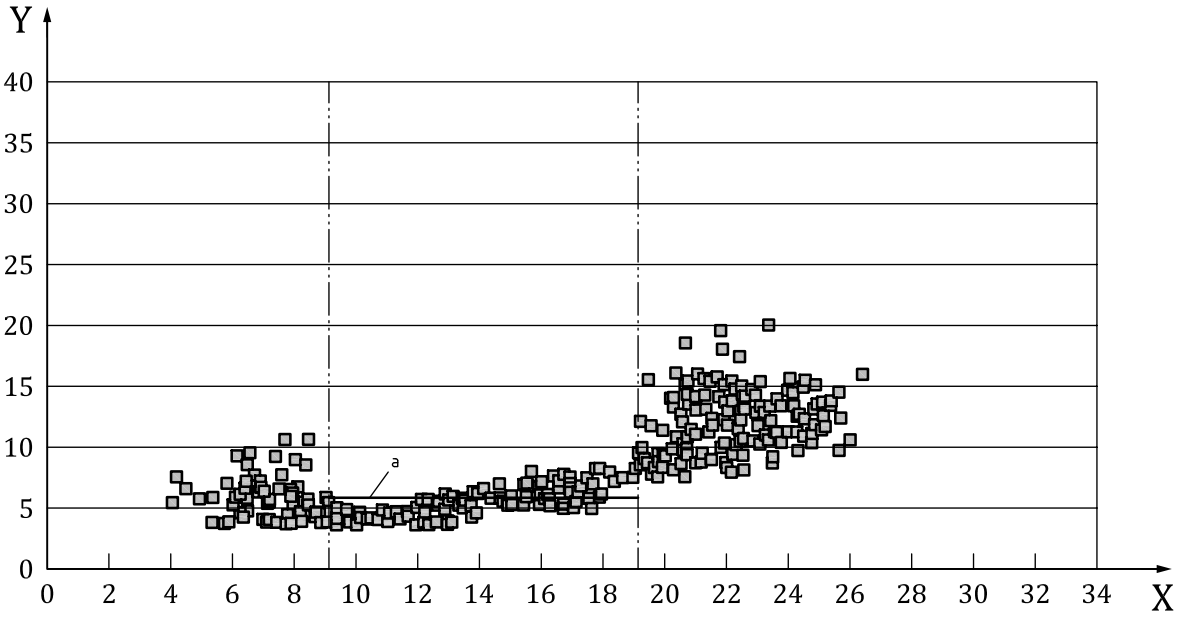
Using the values measured for the wedge-shaped coating, obtained in accordance with ISO 28199-1:2021, 9.4.4, plot the surface texture values against the film thickness. Figures 7 and 8 show examples of short-wavelength (<3 mm) and long-wavelength (≥3 mm) surface texture values plotted against film thickness.

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 (µm)

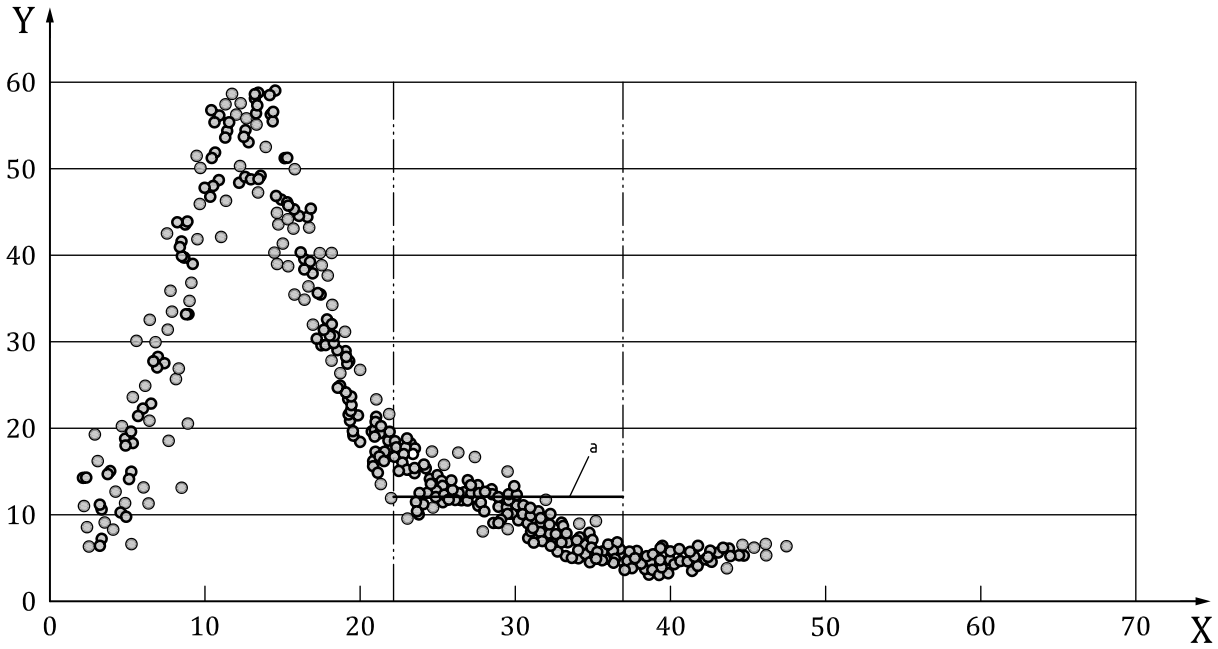
Y short-wavelength values

[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.



Key

X film thickness (µm)

Y long-wavelength values

[a] Mean value of the long-wavelength values within the process window.

Figure 8 — Surface texture as a function of film thickness with a sample process window

10 Mottling

10.1 General

Mottling is determined by evaluation of the values measured for the applied wedge-shaped or constant-thickness (within the process window) base coat and for a constant-thickness clear coat, obtained in accordance with ISO 28199-1:2021, 9.4.

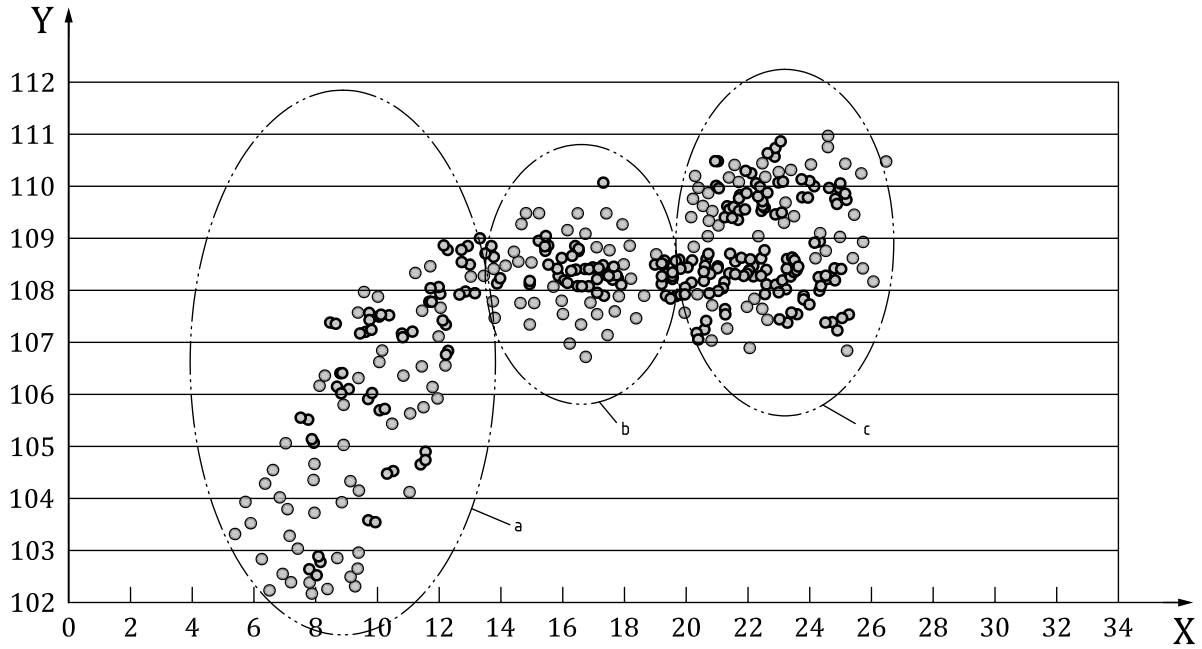
10.2 Evaluation

10.2.1 Measurement techniques

Measure the lightness value L^*, preferably using a colour measuring device, and evaluate it. Other suitable measuring devices that can be used to evaluate mottling may be used. Figure 9 shows an example of lightness plotted against film thickness.

Mottling has occurred if significant variation of the L^* values, including an intermediate flash-off time close to that in the process, occurs between the first and second spray stages. The mottling range is limited within the ranges of hiding power and re-dissolving. These ranges can also be considered as mottling.

Where mottling occurs, clear clusters of measured points with different levels of lightness L^* at the same film thickness are found.



Key

X film thickness (µm)

Y lightness $L^*25°$

a Hiding power mottling at low film thickness.

b Mottling caused by material or application.

c Wet mottling at high film thickness, possibly caused by running material.

Figure 9 — Example of bad mottling

10.2.2 Visual evaluation

Evaluate the samples visually under the evaluation conditions agreed between the interested parties.

11 Test report

Prepare a test report in accordance with ISO 28199-1:2021, Clause 12.

Bibliography

[1] ISO 2808, *Paints and varnishes — Determination of film thickness*

[2] ISO 2813, *Paints and varnishes — Determination of gloss value at 20°, 60° and 85°*

[3] ISO 18314-1, *Analytical colorimetry — Part 1: Practical colour measurement*

[4] ISO 28199-3, *Paints and varnishes — Evaluation of properties of coating systems related to the spray application process — Part 3: Assessment of sagging, formation of bubbles, pinholing and hiding powerfilm*

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