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

**Part 1:  
Vocabulary and preparation of test  
panels**

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

*Partie 1: Vocabulaire et préparation des panneaux d'essai*

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CH-1214 Vernier, Geneva  
Phone: +41 22 749 01 11  
Email: [copyright@iso.org](mailto:copyright@iso.org)  
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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 28199-1:2009), which has been technically revised. It also incorporates the Technical Corrigendum ISO 28199-1:2009/Cor.1: 2009.

The main changes to the previous edition are as follows:

- the terms "minimum film-build", "locally related measurements" and "locally unrelated measurements" have been deleted;
- the terms "bubble formation limit" and "cratering" have been moved to ISO 28199-3;
- the terms "measurement pattern" and "dynamic spray pattern" have been added;
- the distinction between long-wavelength and short-wavelength ranges for the surface texture (3.13) has been deleted;
- the descriptions of the automatic painting machine (5.1) and the device for automatic positioning of measuring devices (5.2) have been revised;
- the description of the film thickness wedge (8.4) has been revised;
- the measurement pattern for colour measurement (9.4.3) has been adapted in line with the measurement pattern for texture measurement (9.4.4) for version A of the samples;
- the measurements of mottling (9.4.5) and gloss (9.4.6) have been added;
- examples of applications with high-speed rotation have been added as new Figure 2 and in Annex A;
- the normative references have been updated;

— the text 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).

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## 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 settings of the particular user. A coating material is, therefore, to be understood as a semi-manufactured product that only achieves 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 ISO 28199 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 to be evaluated for coating materials and coatings depend on the film thickness, so a coating system of increasing or constant thickness is applied to one or more test panels under defined conditions depending on the surface properties to be tested.

The following characteristics are measured (in this document):

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

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

- Colour stability or colour evaluation, process hiding power, redissolving, overspray absorption, wetting, surface texture and mottling (ISO 28199-2). The surface texture can be measured both independently of the film thickness and at constant film thickness. Mottling is preferably measured at constant film thickness.
- 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 1: Vocabulary and preparation of test panels

### 1 Scope

This document defines terms relating to the evaluation of coating materials in research, development and production with regard to their suitability and safety for industrial processes and error analysis.

This document also specifies methods for the preparation of test panels and the subsequent measurement of film thickness, colour, surface texture and other measurable surface properties.

### 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 1513, *Paints and varnishes — Examination and preparation of test samples*

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

ISO 3270, *Paints and varnishes and their raw materials — Temperatures and humidities for conditioning and testing*

ISO 15528, *Paints, varnishes and raw materials for paints and varnishes — Sampling*

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

ISO 28199-2, *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*

ISO 28199-3, *Paints and varnishes — Evaluation of properties of coating systems related to the spray application process — Part 3: Visual assessment of sagging, formation of bubbles, pinholing and hiding power*

### 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:

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

### 3.1 bubble

closed or already burst blister in a layer, arising when solvents or cleavage products evaporate from chemical crosslinking

Note 1 to entry: If bubbles are caused by the process control, the formulation components or both, the viscosity of the paint film has increased too rapidly during the drying phase so that solvents or reaction products still in the paint film have built up at the polymer paint skin which forms, usually resulting in closed blisters and sometimes resulting in burst blisters. Discontinuities can be identified in more detail using a cross-section.

### 3.2 colour stability

non-variability, or variability within agreed tolerances, of colour despite variation of influencing factors

Note 1 to entry: Examples of influencing factors are thickness and application method.

### 3.3 measurement pattern

distance between individual measurements on the test panel in the dx and dy directions

### 3.4 mottling

non-uniform appearance of a film caused by the presence of irregularly shaped, randomly distributed areas on the surface that vary in colour and/or gloss

[SOURCE: ISO 4618:2014, 2.160]

### 3.5 overspray absorption

ability of a coating material already applied to absorb overspray particles of the same coating material resulting from a subsequent application

Note 1 to entry: Evidence of poor overspray absorption is shown, for example, by raised *surface texture* (3.12) and low *colour stability* (3.2) as well as *mottling* (3.4).

### 3.6 pinholing

presence of small holes in a film or coating resembling those made by a pin

Note 1 to entry: Pinholes can be caused by gas inclusions in the base coat that reveal a discontinuity after the application of the clear coating material. They are often the result of inappropriate process parameters. Pinholes are similar to craters and *bubbles* (3.1). Discontinuities can be identified in more detail using a cross-section.

[SOURCE: ISO 4618:2014, 2.195, modified — Note 1 to entry added.]

### 3.7 process hiding power

minimum thickness above which the complete coating system in combination with the colour of the complete substrate achieves *colour stability* (3.2) or the colour location achieves a value agreed by the interested parties

Note 1 to entry: See also “hiding power”, defined in ISO 4618:2014, 2.138, as “ability of a coating material or a coating to obliterate the colour or the differences in colour of a substrate”.

### 3.8 redissolving

mutual effects between an already applied coating material and a subsequently applied coating material where components of the subsequently applied coating interact with the already applied coating

Note 1 to entry: The interaction can be recognizable by a change in colour, for example.



**3.9****sagging**

downward movement of a coating material during application and/or drying or curing in a vertical or an inclined position that results in irregularities in the dry coat

[SOURCE: ISO 4618:2014, 2.221, modified — "or curing" added in the definition.]

**3.10****static spray pattern**

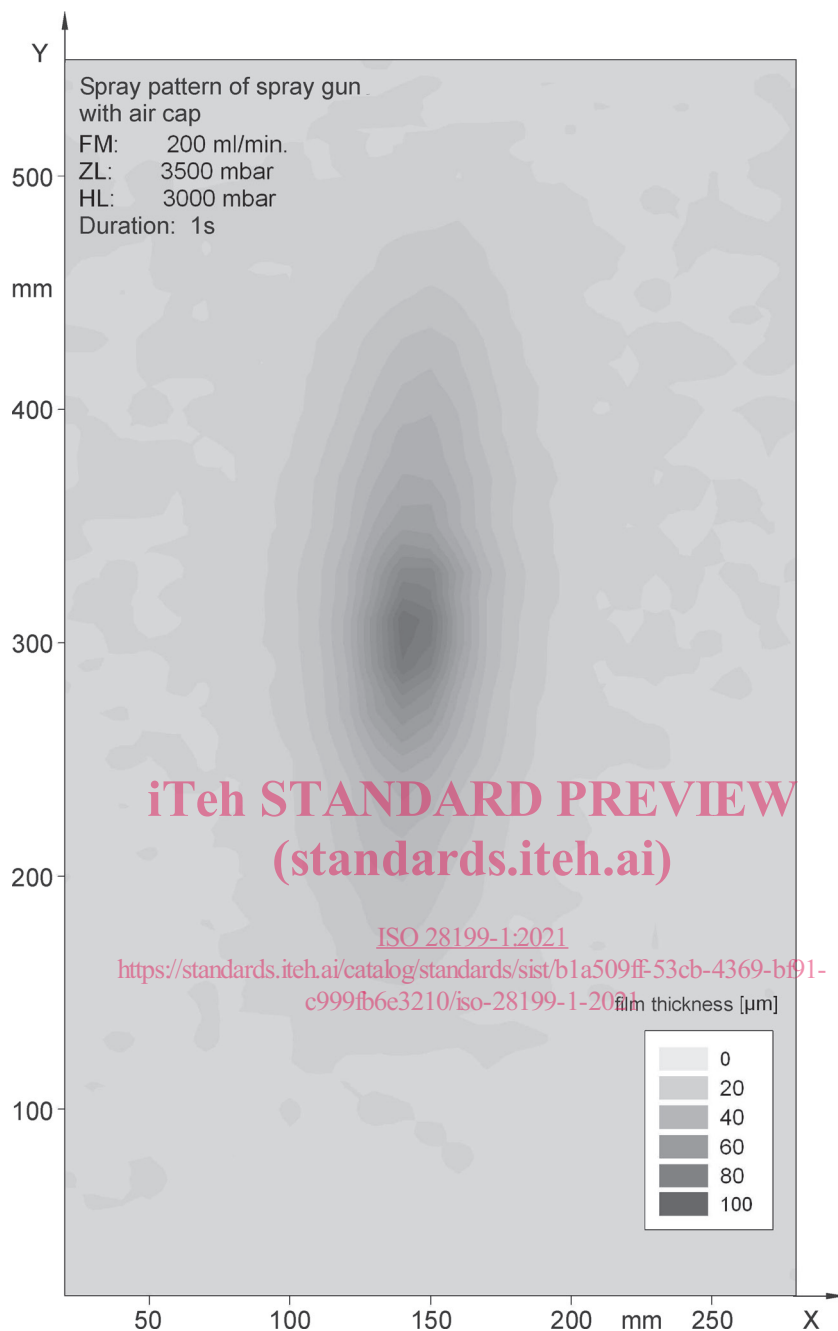
distribution of the coating material after spray application using defined parameters, with both coated object and spray application system at rest

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

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#### Key

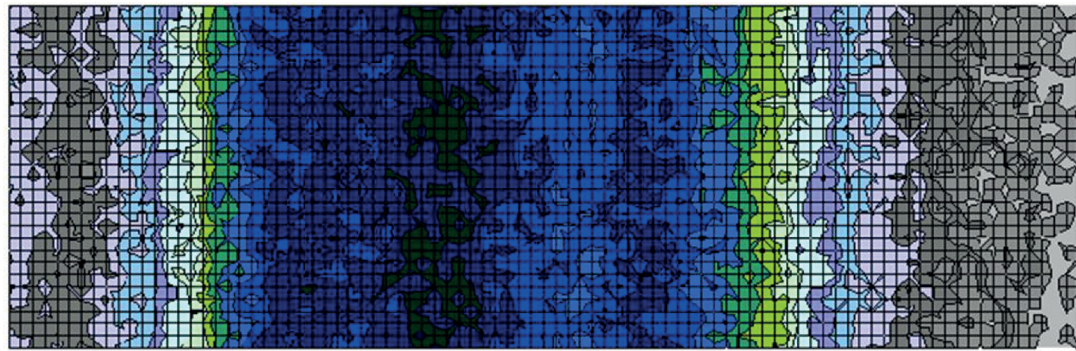
- X width of the test panel, in millimetres
- Y length of the test panel, in millimetres

**Figure 1 — Example of a static spray pattern**

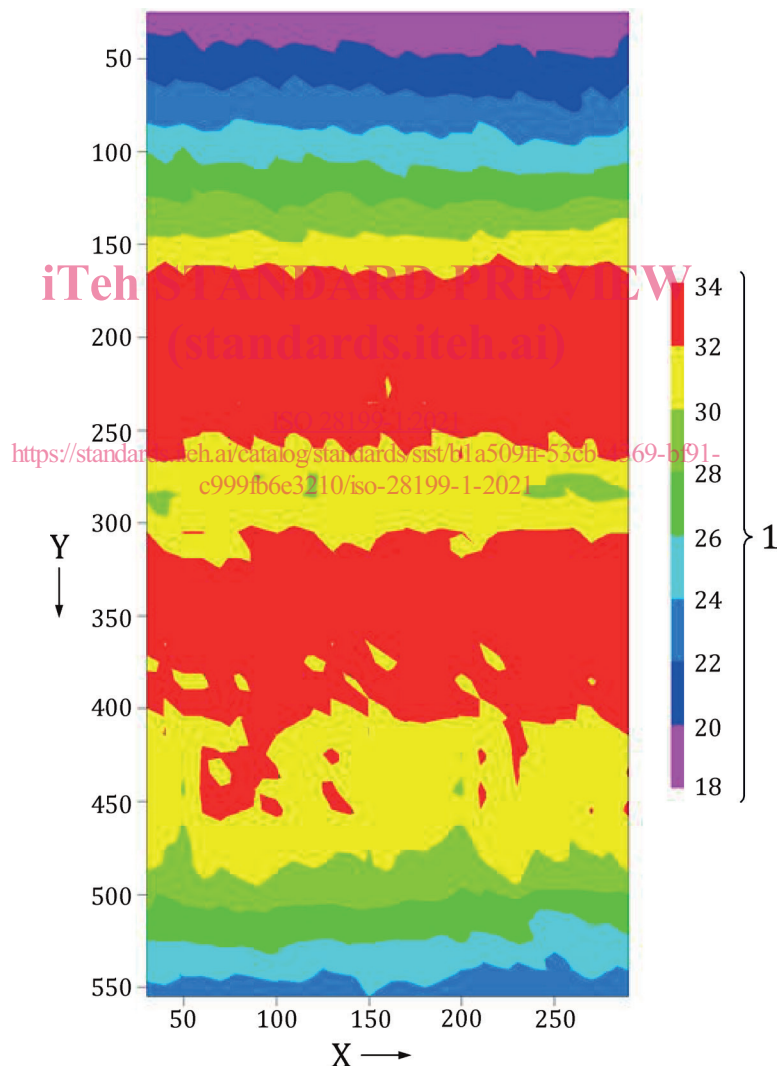
### 3.11 dynamic spray pattern

distribution of the coating material after spray application using defined parameters, with coated object and spray application system in relative motion

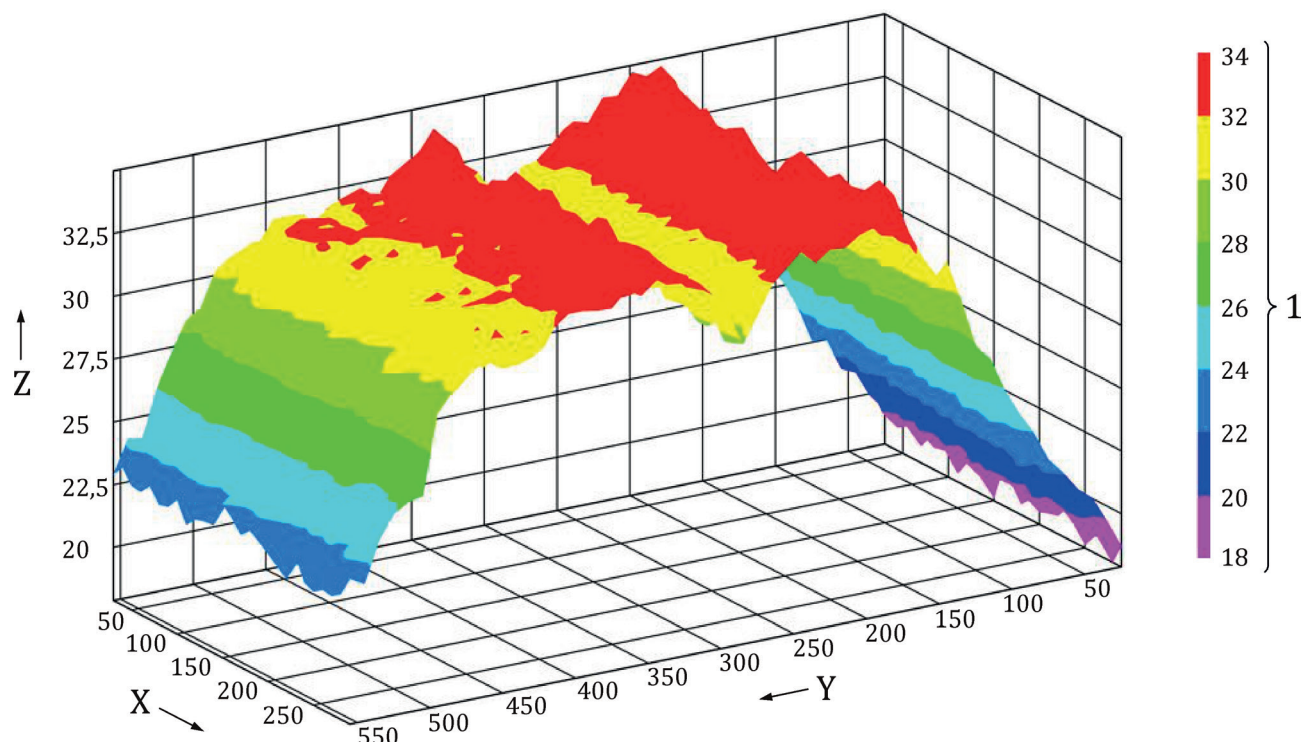
Note 1 to entry: See [Figure 2](#).



a) Pneumatically sprayed



b) Applied with high-speed electrostatic rotation — two-dimensional view



c) Applied with high-speed electrostatic rotation — three-dimensional view

#### Key

- X width of the test panel, in millimetres
- Y length of the test panel, in millimetres
- Z film thickness, in micrometres
- 1 film thickness, in micrometres

NOTE Film thickness ranges shown in different colours.

Figure 2 — Example of a dynamic spray pattern

### 3.12 surface texture

visual appearance and visible recognisability of structures in the coating surface

Note 1 to entry: The recognizability of the surface texture depends on the topographic characteristics, the observation distance and the image clarity of the surface. In the case of the so-called “orange peel” texture that can occur with coatings, the ranges of surface wavelength are between 0,1 mm and 30 mm.

Certain characteristic parameters are calculated from these wavelength ranges by the interested parties. The surface texture is influenced by the levelling (as defined in ISO 4618) of the still-liquid coating and by the substrate, for example.

### 3.13 wetting

complete coverage of a substrate when a coating material forms a continuous film on a substrate

## 4 Principle

The coating material to be tested is applied to a test panel. Various optical properties are measured by an appropriate procedure dependent on the film thickness.