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Third edition
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Paints and varnishes — Determination of hiding power —

Part 3: Determination of hiding power of paints for masonry, concrete and interior use

Peintures et vernis — Détermination du pouvoir masquant — Partie 3: Détermination du pouvoir masquant pour des peintures bâtiments, béton et utilisation en intérieur

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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).

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).

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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.

This document was prepared by Technical Committee ISO/TC 35, *Paints and varnishes*, Subcommittee SC 9, *General test methods for paints and varnishes*.

This third edition cancels and replaces the second edition (ISO 6504-3:2006), which has been technically revised. The main changes compared to the previous edition are as follows:

- the title and Scope have been restricted to paints for masonry and concrete;
- a definition for light-coloured paint has been added;
- a new method (method C), which is suitable for waterborne coating materials only, has been introduced;
- the determination of the mass per unit area of the dry coating and the determination of the practical spreading rate have been deleted (ISO 3233-3 can be used instead);
- the reference to a fixed spreading rate has been deleted from the foreword, scope and test report (it had already been deleted from the procedure in the previous edition);
- the historic precision values for methods A and B have been deleted from the normative part and information on a new interlaboratory comparison on method C has been added in an informative annex, i.e. Annex A;
- the normative references have been updated.

A list of all parts in the ISO 6504 series can be found on the ISO website.

Introduction

Two techniques are available for substrate preparation and measurement when determining the hiding power of paints for masonry and concrete:

a) application to colourless, transparent foil, the coated foil being subsequently placed in turn over black and white panels;

b) direct application to black and white charts.

The spreading rate is important for the determination of the hiding power ratio. The spreading rate can be either determined according to ISO 3233-3 or according to another simplified method described in the standards applicable to coating materials for interior walls and ceilings as specified in EN 13300.

Because different operators using the same draw-down device will obtain coatings differing significantly in thickness, an absolute method for the determination of opacity is described in this document. Collaborative trials between groups of experts from a number of countries have shown that reproducible results can be obtained by determination of the hiding power corresponding to a precisely specified spreading rate by interpolation between measurements at two or more measured coating thicknesses nearby and enclosing the specified spreading rate. The interested parties might agree on the specified spreading rate.

The methods are based on the observation that hiding power is an approximately linear function of reciprocal spreading rate, over a restricted coating thickness range which also corresponds to that used for normal application of white or light-coloured paints. It is thus possible to interpolate graphically or by computation, with satisfactory accuracy, between results obtained with coatings of different thicknesses.

Paints and varnishes — Determination of hiding power —

Part 3:
Determination of hiding power of paints for masonry, concrete and interior use

1 Scope

This document specifies methods for determining the hiding power given by paint coats of white or light colours of tristimulus values Y and Y_{10} greater than 25, applied to a black and white chart, or to a colourless transparent foil. In the latter case the tristimulus values Y and Y_{10} are measured over black and white panels. Subsequently, the hiding power is calculated from these tristimulus values.

This document also specifies a simple method for calculating the spreading rate for paints with a volatile matter content with low evaporation speed, e.g. coatings for interior walls and ceilings as specified in EN 13300.

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 2811 (all parts), *Paints and varnishes — Determination of density*

ISO 3251, *Paints, varnishes and plastics — Determination of non-volatile-matter content*

ISO 3233-3:2015, *Paints and varnishes — Determination of the percentage volume of non-volatile matter — Part 3: Determination by calculation from the non-volatile-matter content determined in accordance with ISO 3251, the density of the coating material and the density of the solvent in the coating material*

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

EN 13300, *Paints and varnishes — Water-borne coating materials and coating systems for interior walls and ceilings — Classification*

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
light-coloured paint
coating with tristimulus values Y and Y_{10} greater than 25, measured with a spectrophotometer on a black and white substrate

[SOURCE: ISO 6504-1:2019, 3.1]

3.2
spreading rate
surface area that can be covered by a given quantity of coating material to give a dried film of requisite thickness

Note 1 to entry: It is expressed in m^2/l or m^2/kg.

Note 2 to entry: See also application rate, practical spreading rate and theoretical spreading rate.

[SOURCE: ISO 4618:2014, 2.238]

3.3
practical spreading rate
spreading rate (3.2) which is obtained in practice on the particular substrate being coated

[SOURCE: ISO 4618:2014, 2.203]

3.4
theoretical spreading rate
spreading rate (3.2) calculated solely from the volume of non-volatile matter

[SOURCE: ISO 4618:2014, 2.256]

3.5
hiding power
ability of a coating to obliterate the colour or colour differences of the substrate

Note 1 to entry: The use of the German expressions "Deckkraft" und "Deckfähigkeit" should be avoided.

Note 2 to entry: The term "coverage" is ambiguous because it is used in some instances to refer to hiding power and in others to mean spreading rate. The more precise terms hiding power and spreading rate should always be used.

[SOURCE: ISO 4618:2014, 2.138]

3.6
tristimulus values (of a colour stimulus)
amounts of the three reference stimuli, in a given trichromatic system, required to match the colour of the stimulus considered

Note 1 to entry: In the CIE standard colorimetric systems, the tristimulus values are represented by the symbols X, Y, Z and X_{10}, Y_{10}, Z_{10}.

[SOURCE: ISO 11664-2:2007, 3.14]

4 Symbols and abbreviated terms

A_c	dry area of the coated charts of the area cut out in each case
A_f	dry area of the coated foils of the part cut out in each case
A_n	dry area of the part of the foil or charts cut out in each case
A_{wc}	wet area of the coated charts
H_{10}	hiding power
H_{10c}	hiding power of the coated chart
H_{10f}	hiding power of the coated foil
H_{10cl}	hiding power for the chart with the low coating thickness

H_{10ch}	hiding power for the chart with the high coating thickness
m	slope of the straight line
$\bar{m}_c$	mean value of the mass of the coated charts
$\bar{m}_f$	mean value of the mass of the coated foils
$\bar{m}_{uf}$	mean value of the mass of the uncoated foils
m_{uc}	mass of the uncoated chart
m_{wc}	mass of the wet coated chart
m_{wch}	mass of the high wet-film thickness on the chart
m_{wcl}	mass of the low wet-film thickness on the chart
n	interception of the Y-axis at the point zero of the X-axis, P(0,n)
NV	non-volatile matter content of the coating material
NV_w	the non-volatile-matter content of the wet coating
ρ_{Ac}	surface mass density of the dry coating on the charts
ρ_{Af}	surface mass density of the dry coating on the foils
ρ_{An}	surface mass density of the dry coating on the foils or charts or wet coating on the charts
ρ_{Awch}	surface mass density of the coat with the high wet-film thickness on the chart
ρ_{Awcl}	surface mass density of the coat with the low wet-film thickness on the chart
ρ_1	density of the coating material
$_{st}Am$	theoretical spreading rate
s_{tAVg}	given theoretical spreading rate
s_{tAVh}	theoretical spreading rate for the chart with the high coating thickness
s_{tAVl}	theoretical spreading rate for the chart with the low coating thickness
s_{tcm}	theoretical spreading rate of the dry coating on the charts relative to the mass
s_{tcV}	theoretical spreading rate of the dry coating on the charts relative to the volume
s_{tfm}	theoretical spreading rate of the dry coating on the foils relative to the mass
s_{tfV}	theoretical spreading rate of the dry coating on the foils relative to the volume
t_{td}	theoretical dry-film thickness
t_{tc}	theoretical dry film thickness of the coating on charts
t_{tf}	theoretical dry film thickness of the coating on foils
t_{tn}	theoretical dry film thickness of the coating on foils or charts
t_W	theoretical wet-film thickness

t_{wl}	theoretical low wet-film thickness
t_{wh}	theoretical high wet-film thickness
$\bar{Y}_{10b}$	mean value of the tristimulus value measured over the black areas
$\bar{Y}_{10bh}$	mean value of the tristimulus value measured over the black areas of the high coating thickness
$\bar{Y}_{10bl}$	mean value of the tristimulus value measured over the black areas of the low coating thickness
$\bar{Y}_{10w}$	mean value of the tristimulus value measured over the white areas
$\bar{Y}_{10wh}$	mean value of the tristimulus value measured over the white areas of the high coating thickness
$\bar{Y}_{10wl}$	mean value of the tristimulus value measured over the white areas of the low coating thickness
X, Y, Z	tristimulus values of test stimulus calculated using the colour-matching functions of the CIE 1931 standard colorimetric system (also known as the CIE 2° standard colorimetric system) [See ISO 11664-4:2007, Clause 3]
X_{10}, Y_{10}, Z_{10}	tristimulus values of a specific white colour stimulus calculated using the colour-matching functions of the CIE 1964 standard colorimetric system

Where tristimulus values are calculated using the colour-matching functions of the CIE 1964 standard colorimetric system (also known as the CIE 10° standard colorimetric system), a subscript 10 shall be added to all the above symbols (See ISO 11664-4:2007, Clause 3).

5 Principle

For method A, coated transparent foils are fixed over a black and white panel. The spreading rate is calculated from the measurements of the surface mass density and the theoretical dry-film thickness. The tristimulus values Y_{10} of the coated foils are measured over the black and white areas. The hiding power is calculated as a quotient of these values as a percentage for each coated foil.

For method B, black and white charts are coated and dried (or stoved). The spreading rate is calculated from the measurements of the surface mass density and the theoretical dry-film thickness. The tristimulus values Y_{10} of each coated chart are measured over the black and white areas. The hiding power is calculated as a quotient of these values as a percentage for each coated chart.

For method C, black and white charts are coated. The spreading rate is calculated from the measurements of the coated area (whole charts), of the density of the coating material and the mass difference of the uncoated and coated charts. Then the coating is dried. The tristimulus values Y_{10} of each coated chart are measured over the black and white areas. The hiding power is calculated as a quotient of these values as a percentage for each coated chart.

6 Apparatus

Ordinary laboratory apparatus and glassware, together with the following:

6.1 Substrate, conforming to the requirements of 8.1.1 or 8.1.2.

6.2 Three colourless transparent foils (method A), untreated.

6.3 Three black and white charts (method B) and two or four (see 6.4) black and white charts (method C), all the same size and measuring at least 100 mm × 200 mm, printed and varnished to give adjacent black and white areas readily wetted by, but impervious to, solvent- or water-based paints.

The black and white areas shall have dimensions bigger than the measurement area of the spectrophotometer. The tristimulus value Y_{10} of the white areas of the charts shall be 80 ± 2 when measured using a spectrophotometer or spectrophotometer complying with 6.5, and that of the black area shall not be greater than 5, unless otherwise agreed.

To avoid errors due to variation from one batch of charts to another, the charts used for the test shall come from the same batch.

If the chart is a metal plate, both the black and the white areas shall be coated on the back and edges with black paint or adhesive tape to exclude light reflected from the back.

Ensure that only black and white charts without optical brighteners are used.

6.4 Film applicators, selected to give a range of films of uniform wet film thickness.

For method C, the film applicators need to be of slightly different sizes, i.e. max. 50 µm difference in size in order to give suitable coating thicknesses, allowing the assumption of linearity in spreading rate for the calculation. The gap of the applicators depends on the type of coating material and its viscosity.

The application of uniform films is facilitated by the use of automatic applicators, which are recommended.

If a coating material with an unknown relation between film applicator gap height and spreading rate is tested, use up to four different film applicators with different gap heights to cover the given spreading rate.

6.5 Spectrophotometer, to measure the tristimulus value Y_{10}.

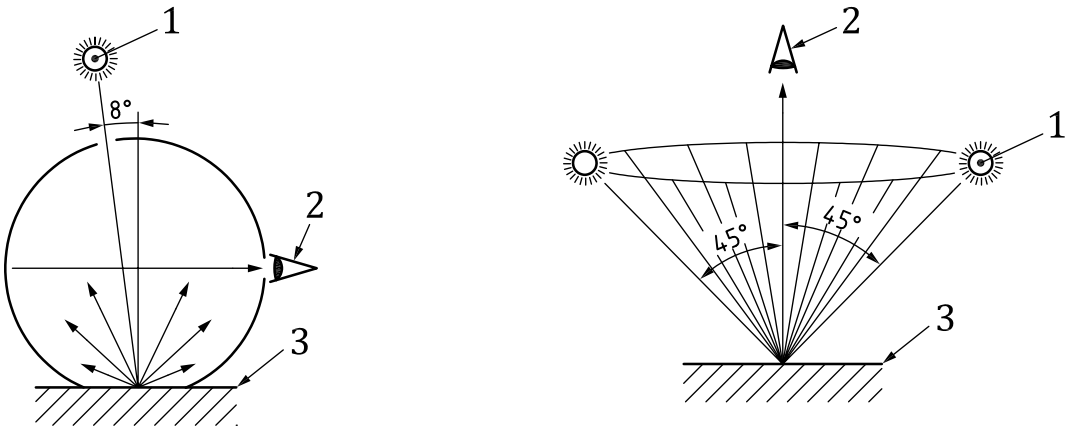
It is recognized that the relative geometrical arrangement of the illumination beam and the light detector can affect the measurement of Y_{10}, but it is considered that variations arising from this factor in commercial spectrophotometers should be considerably less than the reproducibility limit stated in Clause 9. When using the sphere geometry, the surface reflection has to be considered by either:

a) reducing the tristimulus value Y_{10} by the corresponding surface reflection correction value in Table 1 (for an example, see Figure 1), or

b) by measuring the tristimulus value Y_{10} with correction for surface reflection with a sphere 8° (diffuse) geometry (for an example, see Figure 2).

Table 1 — Surface reflection correction with respect to the gloss property of coating

Designation	Angle of incidence	Reflectance	Surface reflection correction
Gloss	60°	≥70	4
Mid sheen	60°	<70	2
	85°	≥10	
Matt	85°	<10	0
Dead-matt	85°	<5	0
NOTE For columns 1 to 3 see EN 13300, except that the reflectance limit from gloss to mid sheen is corrected from 60 to 70.			

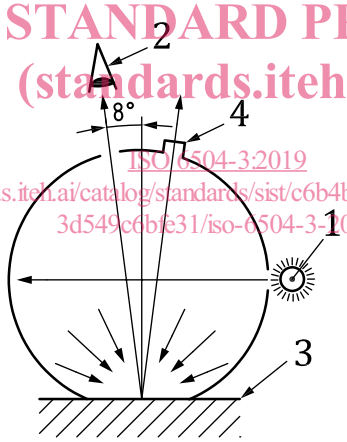


a) Sphere geometry **b) 45:0° geometry**

Key

1 light source, daylight D65
2 photo detector
3 test area

Figure 1 — Example for a spectrophotometer; sphere and 45:0° geometry



Key

1 light source, daylight D65
2 photo detector
3 test area
4 gloss trap

Figure 2 — Example for a spectrophotometer; sphere with gloss trap

6.6 Analytical balance, capable of weighing to the nearest 0,1 mg.

7 Sampling

Take a representative sample of the product to be tested, as described in ISO 15528.

Examine and prepare the sample for testing as described in ISO 1513.

