INTERNATIONAL STANDARD

ISO 20266

First edition
2018-06

Paints and varnishes — Determination of image clarity (degree of sharpness of reflected or transmitted image)

Peintures et vernis — Détermination de la netteté de l'image (degré de netteté de l'image réfléchie ou transmise)

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Foreword

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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*.

Introduction

Visual assessment of the image clarity of paint films (coatings) is carried out by evaluating the sharpness of an image reflected from a surface, using a specified incident angle, for reflection. For transmission, image sharpness is evaluated by viewing a suitable target through the paint films. The degree of image clarity is influenced by the clearness, surface irregularities and haziness of a surface(s). Gloss values and haze values do not correctly assess this phenomenon. Image clarity is not the same as, and should not be confused with, gloss or haze. Therefore, standardized methods for determining the optical parameter of image clarity are needed.

Paints and varnishes — Determination of image clarity (degree of sharpness of reflected or transmitted image)

1 Scope

This document specifies an instrumental method for determining the image clarity on paint films (coatings) by measuring reflection from the specimen surface or transmission through the specimen.

The method can be applied only to a flat surface.

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 1514, *Paints and varnishes — Standard panels for testing*

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

ISO 4618, *Paints and varnishes — Terms and definitions*

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

ISO 17221, *Plastics — Determination of image clarity (degree of sharpness of reflected or transmitted image)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 4618 and the following 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
image clarity
degree of sharpness of an image reflected by a specimen or transmitted through a specimen

Note 1 to entry: Image clarity is expressed as a percentage (%).

[SOURCE: ISO 17221:2014, 3.1]

4 Principle

For the measurement of image clarity, a lamp illuminates the narrow source aperture-slit. The collimating lens projects a parallel beam upon the specimen. The image is either reflected from or transmitted through the specimen, as appropriate. The image is received by the de-collimating lens and focused upon the optical mask. The light passing through the optical mask is received by the light receptor. This resultant signal is processed yielding image clarity values.

5   Limitations

Temperature and humidity are important parameters affecting test results. Deviations from the requirements specified can lead to results that are not comparable. However, the interested parties may agree upon alternative parameters and these parameters shall be reported.

6   Apparatus

The apparatus shall:

— include a light source, a slit, an optical mask, a black glass standard meeting the requirements of ISO 17221, and

— have the geometry characteristics and structure specified in ISO 17221.

7   Sampling

Take a representative sample of the product to be tested (or of each product in the case of a multi-coat system), in accordance with ISO 15528.

Examine and prepare each sample for testing, in accordance with ISO 1513.

8   Test specimen

8.1   Substrate

Unless otherwise agreed, select the substrate in regard to the intended practical use from the substrates described in ISO 1514. The test specimen shall be plane and free of deformations (see Annex A).

8.2   Preparation and coating

Prepare each test specimen in accordance with ISO 1514 and coat it in accordance with the specified method with the coating material or multi-coat system to be tested.

8.3   Drying and conditioning

Dry/harden (stove, if applicable) and age, if applicable, each coated test specimen for the specified period of time and under the specified conditions. Condition the coated test specimens before the test at (23 ± 2) °C and a relative humidity of (50 ± 5) % for at least 16 h. Other conditions for conditioning shall be agreed and indicated in the test report.

Finger prints, dust, or other contaminations on the surface lead to changed and/or imprecise image clarity values. Consequently, the coated test specimens shall be stored and handled accordingly.

In the case of aged samples, the preparation has to eliminate the potential dust, without altering the surface.

8.4   Thickness of coating

Determine the dry film thickness of the coating, in micrometres, in accordance with one of the methods specified in ISO 2808.

For comparative measurements, the film thicknesses shall correspond.

8.5   Specimen size

For transmission and reflection, the size of the test specimen should be

a)   not less than 30 mm × 30 mm,

b)   not larger than 150 mm × 150 mm, and

c)   less than 10 mm in thickness.

9   Procedure

The procedure shall comply with the requirements of ISO 17221.

10 Calculation

Calculate the image clarity value from the wave heights using Formula (1) (see Figure 1):

$$C(n) = \frac{M_n - m_n}{M_n + m_n} \times 100 \, (\%)$$

(1)

where

$C(n)$ is the image clarity value, expressed as a percentage, at n (mm) of the optical mask line width;

M_n is the maximum relative light intensity at n (mm) of the optical mask line width;

m_n is the minimum relative light intensity at n (mm) of the optical mask line width.

NOTE 1   When the image clarity value is high, the image can be seen clearly. On the contrary, when the image clarity value is low, the image is distorted.

NOTE 2   Examples of determination of image clarity are shown in Annex A.

NOTE 3   Precision of the image clarity is shown in Annex B.

Key

X   group

Y   relative light intensity
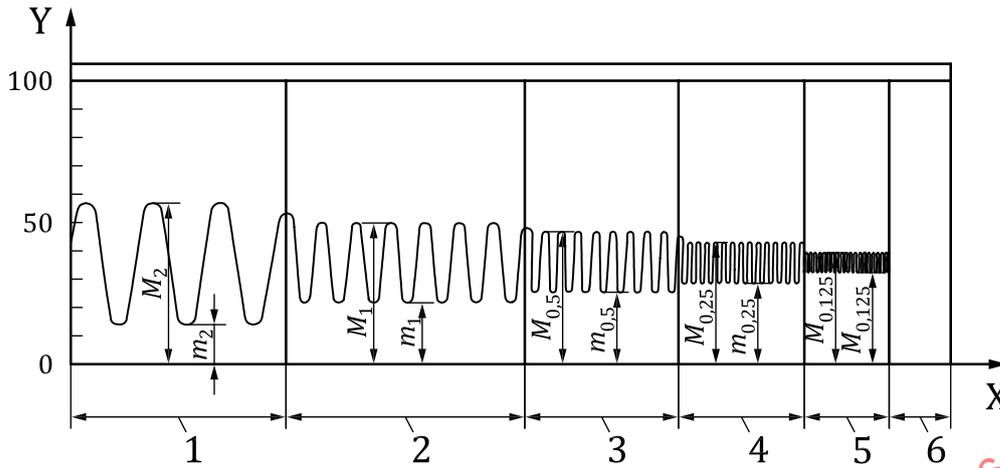
M_n maximum relative light intensity at n (mm) of optical mask line width

m_n minimum relative light intensity at n (mm) of optical mask line width

1   group 1, transparent and opaque lines each 2,0 mm in width

2   group 2, transparent and opaque lines each 1,0 mm in width

3   group 3, transparent and opaque lines each 0,5 mm in width

4   group 4, transparent and opaque lines each 0,25 mm in width

5   group 5, transparent and opaque lines each 0,125 mm in width

6   group 6, opaque line each 1,0 mm in width

Figure 1 — Example of the received relative light intensity of a specimen

11 Test report

The test report shall contain at least the following information:

a)   a reference to this document i.e. ISO 20266:2018;

b)   a description of the specimen measured, including material, shape and surface condition (if each side has different surface condition, the side used for the measurement);

c)   the method of measurement (transmission/reflection);

d)   in case of measurement by reflection, the measurement angle;

e)   if the specimen has the orientation of the specimen relative to the slit, the direction of measurement;

f)   the image clarity value(s) and optical mask line width(s);

g)   any deviations from the procedure described in this document;

h)   any unusual features observed;

i)   the date of the measurement.

Annex A
(informative)

Example of determination

A.1 Selection of optical mask width

It is desirable to select optical mask line width depending on conformity to the visual assessment. There are five optical masks which differ in the line widths of the opaque and transparent areas.

For high image clarity specimens, 0,125 mm and 0,25 mm in line width are used.

For medium image clarity specimens, 0,50 mm in line width is used.

For low image clarity (matt) specimens, 1,0 mm and 2,0 mm in line width are used.

These five widths are sufficient to assess image clarity. Image clarity values of five optical mask line widths are measured at the same time. The optical mask line width is selected to conform to visual assessments referred to in Tables A.1 to A.3.

A.2 Example of image clarity measurement (reflection)

Table A.1 shows gloss values and image clarity values for three types of paint films.

Table A.1 — Measurement of paint films (reflection)

Specimen no.	Specimen surface characteristics	Gloss value (%) 60° gloss units	C(n) Image clarity value(%)					Visual assessment
			C (0,125)	C (0,25)	C (0,5)	C (1,0)	C (2,0)	
1-1	High gloss	90,4	71,1	86,5	91,6	94,6	95,8	Highly glossy
1-2	Gloss	83,3	43,9	59,8	63,2	67,2	74,6	Glossy
1-3	Orange peel	87,7	1,4	2,7	22,3	49,5	92,5	Distorted

Specimens 1-1 and 1-2 are coatings with various gloss values. Specimen 1-3 has orange peel surface.

Gloss and image clarity values of specimen 1-1 and 1-2 agree with visual assessment.

Comparing specimen 1-2 with 1-3, although 1-2 looks glossier and 1-3 looks distorted visually, the gloss value of specimen 1-3 is higher than that of 1-2. In this case, only image clarity values conform to visual assessment with optical mask line widths not larger than 1,0 mm.

NOTE   The gloss values are determined in accordance with ISO 2813.

A.3 Example of painted plastic sheets

Table A.2 shows haze values and image clarity values for three types of painted plastic sheets with 1,5 mm thickness using transmission.

NOTE   The haze values are determined in accordance with ISO 14782.

Table A.3 shows gloss values and image clarity values for the three painted plastic sheets using reflection.

Table A.2 — Measurement of painted plastic sheets (transmission)

Specimen no.	Specimen characteristics	Haze value (%)	$C(n)$ Image clarity value(%)					Visual assessment
			C (0,125)	C (0,25)	C (0,5)	C (1,0)	C (2,0)	
2-1	Not matt coated	0,17	96,9	98,0	98,8	97,2	99,4	Clear
2-2	Matt coated	2,94	48,9	49,7	53,3	56,4	72,7	Slightly hazy
2-3	Coarse matt coated	7,91	12,2	11,6	12,5	17,7	40,5	Hazy

Table A.3 — Measurement of painted plastic sheets (reflection)

Specimen no.	Specimen surface characteristics	Gloss value (%) 60° gloss units	$C(n)$ Image clarity value(%)					Visual assessment
			C (0,125)	C (0,25)	C (0,5)	C (1,0)	C (2,0)	
2-1 no matt coated	Not matt coated	150,2	94,3	95,3	97,7	98,7	99,4	High glossy
2-2 glossy side	Matt coated	101,2	94,7	95,2	96,8	98,0	98,2	Glossy
2-2 matt side		91,5	12,7	14,4	15,4	18,3	26,5	Low glossy (rough surface)
2-3 glossy side	Coarse matt coated	94,8	81,8	94,4	94,6	97,2	97,7	Glossy
2-3 coarse side		55,7	2,6	1,4	2,1	4,1	8,9	Low glossy (rough surface)
NOTE A gloss meter conforming to ISO 2813 with extended range was used to obtain these values.								

Haze values of specimen 2-1 to 2-3 conform to visual assessment as image clarity values do. Gloss values of specimen 2-1, 2-2 glossy side and 2-3 glossy side conform to visual assessment as image clarity values do.

Comparing specimen 2-2 matt coated side with 2-3 glossy side, although 2-2 matt coated side looks rougher and 2-3 glossy side looks glossier visually, their gloss values are almost the same. In this case, only image clarity values conform to visual assessment.

Annex B
(informative)

Precision

B.1 General

The precision data of reflection (see Table B.1) shows repeatability (r) and reproducibility (R) from an interlaboratory study. The study consisted of measurements gathered from six different laboratories, four materials (A1 to A4), six different operators, made on different days on a single make and model instrument.

The precision data of transmission (see Table B.2) shows repeatability (r) and reproducibility (R) from an interlaboratory study. The study consisted of measurements gathered from six different laboratories, four materials (B1 to B4), six different operators, made on different days on a single make and model instrument.

The data obtained from the measurements carried out were analysed using ISO 5725-1.

B.2 Materials

Materials A1 to A4 are painted steel plate measuring 150 mm × 50 mm × 1 mm thick. The surfaces are as follows:

— Material A1: mirror surface;

— Material A2: large orange peel surface;

— Material A3: medium orange peel surface;

— Material A4: small orange peel surface.

Materials B1 to B4 are 50 mm × 50 mm. B1 and B2 are 2 mm thick. B3 and B4 are 0,1 mm thick. The surfaces are as follows:

— Material B1: optical polished glass;

— Material B2: PMMA plate;

— Material B3: plastic film;

— Material B4: matt surface plastic film.

B.3 Instrumentation

The measurements were carried out using an image clarity meter ICM-1T[1].

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1) ICM-1T is an example of a suitable product supplied by Suga Test Instruments Co., Ltd., Japan. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of this product.

B.4 Repeatability

Repeatability is defined as the closeness of agreement between successive results obtained with the same method on identical test material, under the same conditions (same operator, same instrument, same laboratory, short intervals of time) and using the same make and model instrument.

B.5 Reproducibility

Reproducibility is defined as the closeness of agreement between individual results obtained with the same method on identical test material but different conditions (different operators, different instruments, different laboratories and/or different times) and using the same make and model instruments.

Table B.1 — Precision data obtained for a single make and model of instrument (reflection)

Material No.	$\overline{x}$	S_x	S_r	S_R	r	R
C (0,125) Image clarity value (%), measurement method: reflection						
A 1	50,6	2,5	0,8	2,6	2,3	7,4
A 2	12,3	2,2	0,7	2,3	1,9	6,4
A 3	2,0	0,5	0,2	0,5	0,5	1,4
A 4	1,8	0,5	0,2	0,5	0,5	1,4
C (0,25) Image clarity value (%), measurement method: reflection						
A 1	89,4	1,6	0,5	1,6	1,5	4,6
A 2	58,4	1,5	0,6	1,6	1,6	4,5
A 3	3,7	0,4	0,1	0,4	0,3	1,1
A 4	2,6	0,3	0,1	0,3	0,2	0,8
C (0,5) Image clarity value (%), measurement method: reflection						
A 1	93,1	1,0	0,3	1,0	0,8	2,9
A 2	86,2	1,0	0,3	1,0	0,9	2,9
A 3	13,0	1,3	0,2	1,3	0,5	3,6
A 4	5,1	0,5	0,1	0,5	0,2	1,5
C (1,0) Image clarity value (%), measurement method: reflection						
A 1	94,4	0,7	0,3	0,8	0,9	2,2
A 2	91,5	0,6	0,3	0,7	0,9	1,9
A 3	48,4	0,9	0,3	1,0	1,0	2,7
A 4	21,9	0,7	0,2	0,8	0,5	2,1

$\overline{x}$ mean value of six laboratories data

S_x standard deviation of six laboratories data

S_r repeatability standard deviation

S_R reproducibility standard deviation

r 95 % repeatability limit

R 95 % reproducibility limit