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Photography — Photographic reflection prints —

Part 3: Evaluation of glossiness

Photographie — Tirages photographiques par réflexion —

Partie 3: Évaluation de la brillance

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Foreword

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This document was prepared by Technical Committee ISO/TC 42, *Photography*.

A list of all parts in the ISO 20791 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

Glossiness is an optical property regarding reflected light from print surfaces. Many studies have been conducted on glossiness of industrial materials, and several studies have been reported on print materials as well, see References [1] to [6]. It is especially important for photographic prints with respect to printed image characteristic, because there is a wide variety from very high glossy to dead matte surfaces. As stated in ISO/TR 20791-1, several properties affect the gloss perception of photographic prints, see References [7]. Specular gloss and image clarity (distinctness of image) are the two major properties among them. The former relates to the perceived intensity of reflected light and the latter relates to the sharpness of reflected image. There is also a study stating that perceived glossiness of photographic prints is well represented by the combination of these two measurements, specular gloss and image sharpness[8].

Some measurements for properties regarding glossiness have been standardized for industrial materials such as coatings, plastics and papers, see References [9] to [12] and ISO 17221. Among them, the measurement methods for coatings are standardized with specular gloss and image clarity as important properties for the reflection characteristics. Some standards for graphic printing and office printing basically refer to them while adding methods and cautions specific to each application[13] [14]. But there has been no published standard for measuring both specular gloss and image clarity for photographic prints.

This document provides the measurement methods of two major properties to evaluate glossiness of photographic prints: specular gloss and image clarity. The methods are based on the existing documents for coatings and plastics, and specific requirements for photographic prints are defined regarding sample preparation, measurement procedure and reporting.

Photography — Photographic reflection prints —

Part 3: Evaluation of glossiness

1 Scope

This document describes the characterization of glossiness of photographic reflection prints, which consists of specular gloss measurement and image clarity measurement. This document is applicable to any photographic printing technology such as inkjet, thermal dye transfer, electrophotography and silver halide technologies.

NOTE The level of preferred glossiness depends on the application.

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

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

ISO 18913, *Imaging materials — Permanence — Vocabulary*

3 Terms and definitions

For the purposes of this document, the following terms and definitions given in ISO 18913 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 https://www.electropedia.org/

3.1 Terms

3.1.1
glossiness
visual characteristic related to shiny and smooth appearance

Note 1 to entry: Based on this appearance, humans perceive features such as reflection characteristics and roughness of the surface of an object.

3.1.2
specular gloss
ratio of the luminous flux, reflected by the test surface into a specified aperture at the angle of specular reflection, to that from a standard specularly reflecting surface under the same conditions

[SOURCE: ISO 4046-5:2016, 5.107, modified — Note 1 to entry was deleted.]

3.1.3
image clarity
distinctness of image
DOI
degree of sharpness of an image reflected by a specimen or transmitted through a specimen

[SOURCE: ISO 17221:2014, 3.1, modified — the synonym "distinctness of image (DOI)" was added and Note 1 to entry was deleted.]

3.2 Abbreviations

C	cyan
M	magenta
Y	yellow
R	red
G	green
B	blue

4 Overview

This document stipulates evaluation methods of glossiness, based on specular gloss and image clarity. Each measurement method is based on ISO 2813 and ISO 17221 respectively. Specific requirements for photographic prints are described in Clause 5 for sample preparation, Clause 6 and 7 for measurement and Clause 8 for reporting. In addition, other properties which relate to glossiness are described in Annex A.

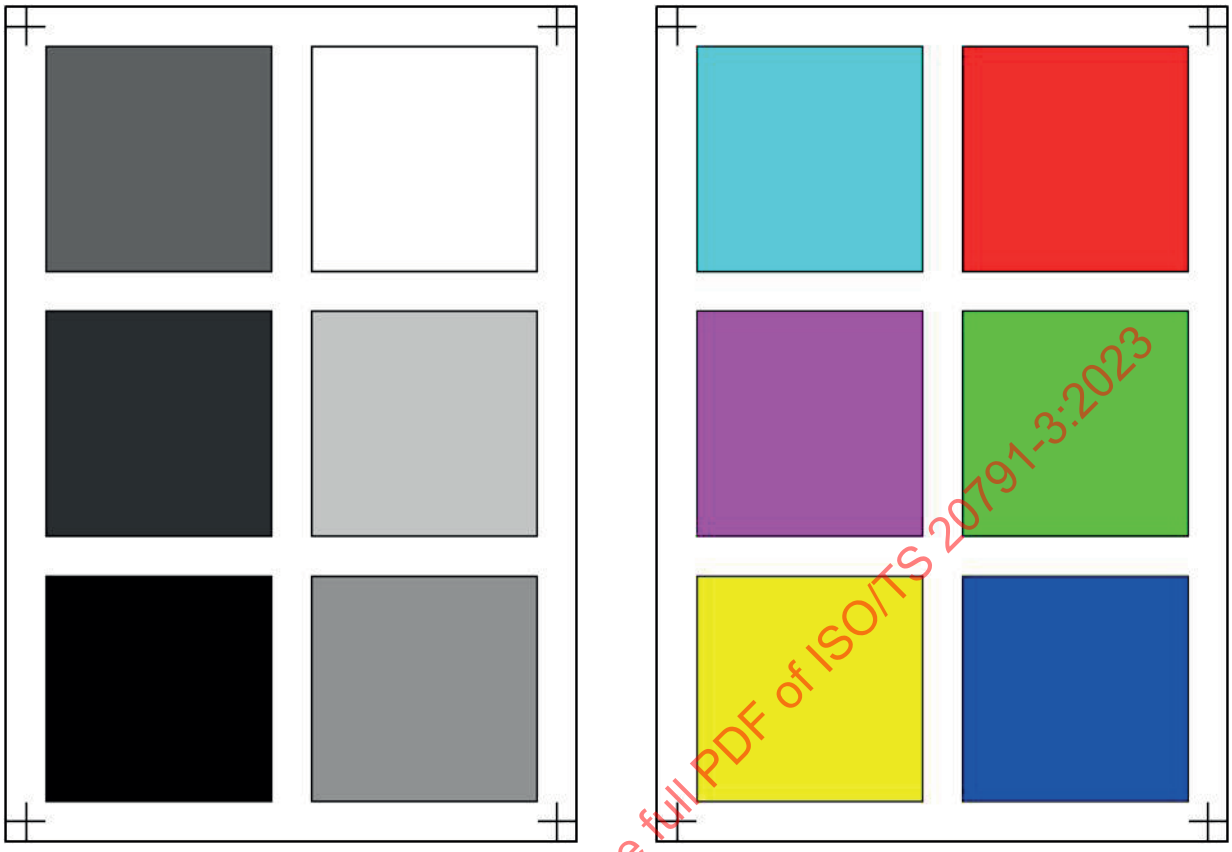
The purpose of this document is to characterize the glossiness of photographic prints. Since the level of preferred glossiness depends on the application, this document does not discuss performance superiority or inferiority. The methods in this document are intended to be used for product design and product comparison and are not intended to be used for daily quality assurance in manufacturing.

5 Sample preparations

5.1 Test targets

At least white (D_{min}) and black patches shall be printed for measurement. Additional colours such as cyan (C), magenta (M), yellow (Y), red (R), green (G), blue (B) and grey are recommended to evaluate the effects of colour or density on measured properties. The sRGB encoded patch values described in ISO 18944 can be applied to test targets for digital printers. Patch size for measurements shall be not less than 25 mm × 25 mm. Examples of test targets are shown in Figure 1. Figure 1 a) can be used for both colour and monochrome prints.

NOTE A larger patch size is sometimes necessary for the measurements of specular gloss especially at a higher angle such as 85°. The manufacturer of each measuring instrument usually provides information about the aperture size and/or the minimum patch size.



a) grey step patches b) C, M, Y, R, G, B colour patches

Figure 1 — Examples of test targets

5.2 Printing

The standard ambient environmental condition for printing shall be a temperature of 23 °C ± 3 °C, and a relative humidity of 50 % RH ± 10 % RH unless it has been confirmed that the temperature and humidity do not affect the properties related to gloss. If it is not possible to conduct the test under the standard environmental condition, the temperature and humidity shall be reported.

Aqueous and solvent inkjet prints, and prints of any type that require curing/stabilization/dry-down shall be conditioned until the curing process is finished. If the duration of curing is unknown, prints should be conditioned for at least two weeks after printing, in an environment with a temperature of 23 °C ± 2 °C, with a relative humidity of 50 % RH ± 5 % RH.

5.3 Specimens

The size of specimen shall not be less than 30 mm × 30 mm to cover the minimum size of 25 mm × 25 mm for a single test patch.

In the case of large size prints, they are cut to fit the above size before measurement.

NOTE The upper and lower limits of the size, where the sample is stably held, can vary depending on thickness of the sample and structure of the sample holder. The specification or recommendation of the manufacturer of the instrument can be referred for clarification.

It is recommended that prints be backed to keep the surface of prints flat during the measurement. Paper boards, plastic plate and metal plates can be used as backing materials. Black coloured boards

are preferable to minimize the effects on the measurements. Backing materials shall be reported if they are applied for measurements.

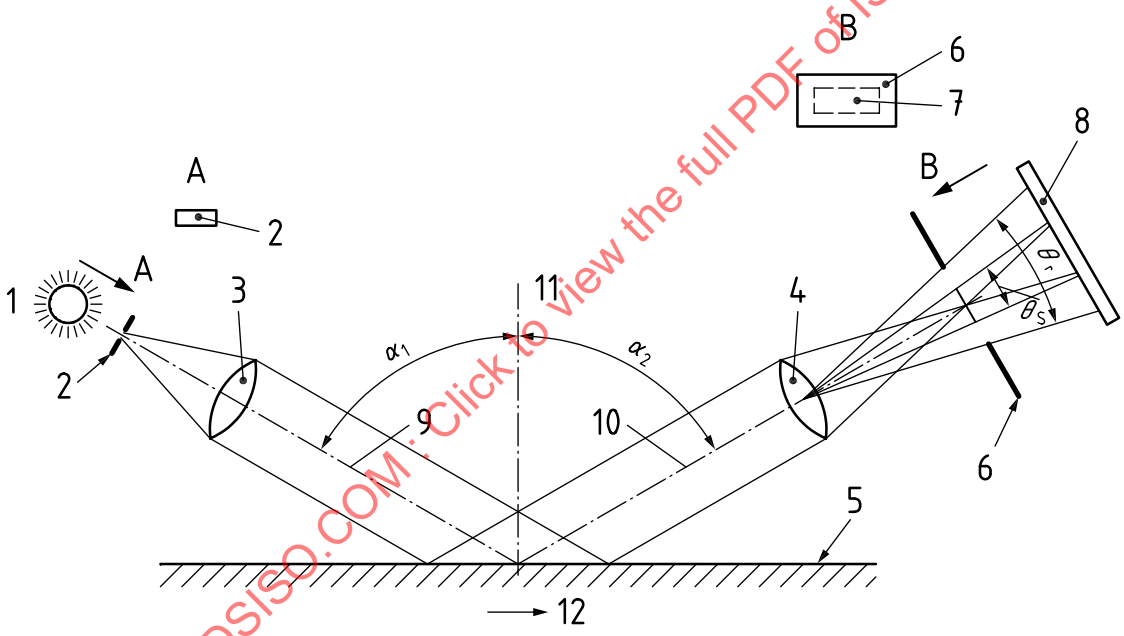
6 Measurement of specular gloss

6.1 General

Specular gloss is relating to the luminous flux reflected from a specimen in specular direction for a specified reflection angle. It is expressed as a ratio of a specimen and a reference glass surface and the ratio multiplied by 100 is treated as a measured value. A glass surface with a refractive index of 1,567 at a wavelength of 587,6 nm is assumed to be the reference for the measurement. The methods in ISO 2813 are applied.

6.2 Apparatus

A glossmeter, as stipulated in ISO 2813, shall be used. It consists of a light source unit, a sample stage and a receptor unit, and has an instrument to adjust the incident angle and the receptor angle. The course of the beam of the glossmeter is illustrated in Figure 2. The apparatus shall have the geometry characteristics and structure specified in ISO 2813.



Key

1	light source (source)	9	optical axis of the incident beam
2	source image aperture	10	optical axis of the receptor beam
3	source lens	11	surface normal of the test specimen
4	receptor lens	12	direction of measurement
5	test surface	α_1	angle between 9 and 11
6	receptor field stop	α_2	angle between 10 and 11
7	image of the source aperture in the receptor field stop	θ_r	receptor aperture angle
8	photo detector (receptor)	θ_s	source image aperture angle

Figure 2 — Course of the beam of the glossmeter (see ISO 2813)

6.3 Procedure

The procedure shall comply with the requirements of ISO 2813. Calibration and adjustment are performed using a reference standard to ensure correct measuring values.

For photographic prints, two directions of measurement, perpendicular and parallel to the printing direction, are required. Each value of the two directions shall be reported as well as the average of the two directions.

Within the three measuring conditions of angle, 20°, 60° and 85° in ISO 2813, the condition of 20° is recommended for photographic prints which have wide variety of surfaces from very high gloss to dead matte surfaces[8].

NOTE The measurement condition of 60° can also be applied to compare a high variety of different surfaces. The measurement condition of 85° is applied for relatively low gloss samples.

7 Measurement of image clarity

7.1 General

Image clarity represents how sharp the reflected image of light source is. In some industrial fields, image clarity is sometimes called distinctness of image (DOI) with the same measuring principles[11].

NOTE Some other methods have also been proposed to measure distinctness of image (DOI) using a different procedure from image clarity[2][15].

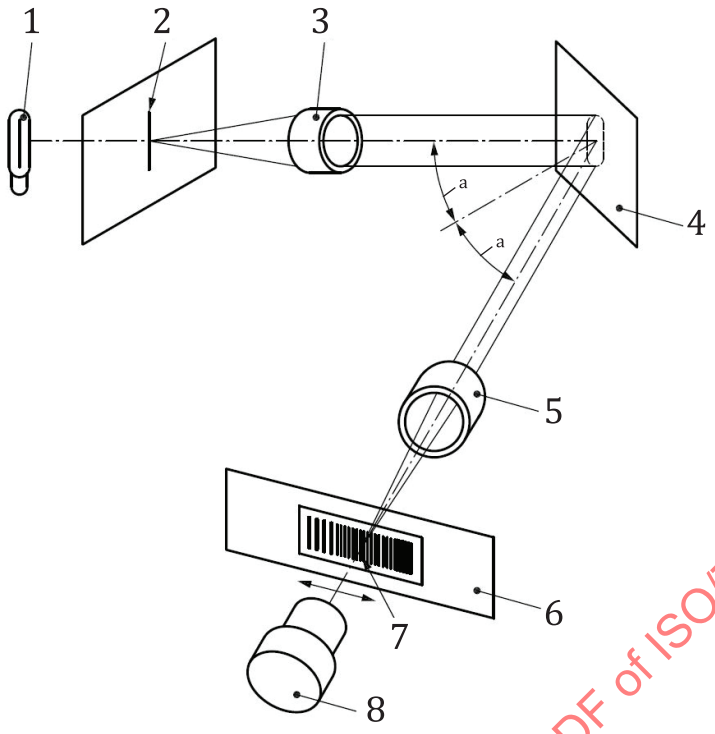
In the past, image clarity has not been widely used in photography, compared to the more widespread use of specular gloss. However, even if prints have a same level of specular gloss, they can appear different if the level of clarity is different. This is especially important when comparing prints made from different printing technologies. Image clarity is useful for differentiating properties in such cases. It is not always essential for quality assurance in daily production but is effective for comparing print products especially made by different surfaces or print technologies.

In this document the measuring methods of image clarity in ISO 17221 are applied.

7.2 Apparatus

The apparatus shall include a light source, a slit, an optical mask and a black glass standard meeting the requirements ISO 17221. It shall have the geometry characteristics and structure specified in ISO 17221. A typical diagrammatic representation is shown in Figure 3. A lamp illuminates the narrow slit. A collimating lens projects a parallel beam upon the specimen. The reflected 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.

ISO 17221 provides five optical mask widths as options. In general, a narrower width is selected for surfaces with sharp reflections and a wider width is selected for surfaces with less sharp reflections.



Key

1	light source	6	optical mask
2	source aperture-slit	7	image of source aperture-slit on the optical mask
3	collimating lens with a focal length 130 mm	8	light receptor
4	specimen	a	Reflected angle of 45° or 60°.
5	de-collimating lens with a focal length 130 mm		

Figure 3 — Typical diagrammatic representation for reflection measurement of image clarity (see ISO 17221)

7.3 Procedure

The procedure shall comply with the requirements of ISO 17221. Calibration and adjustment are performed using a reference standard to ensure correct measuring values.

Calculate the image clarity value, $C(n)$, from the wave heights using Formula (1). Figure 4 shows an example of the received relative light intensity of a specimen.

$$C(n)=\frac{M_n-m_n}{M_n+m_n}\times 100 \tag{1}$$

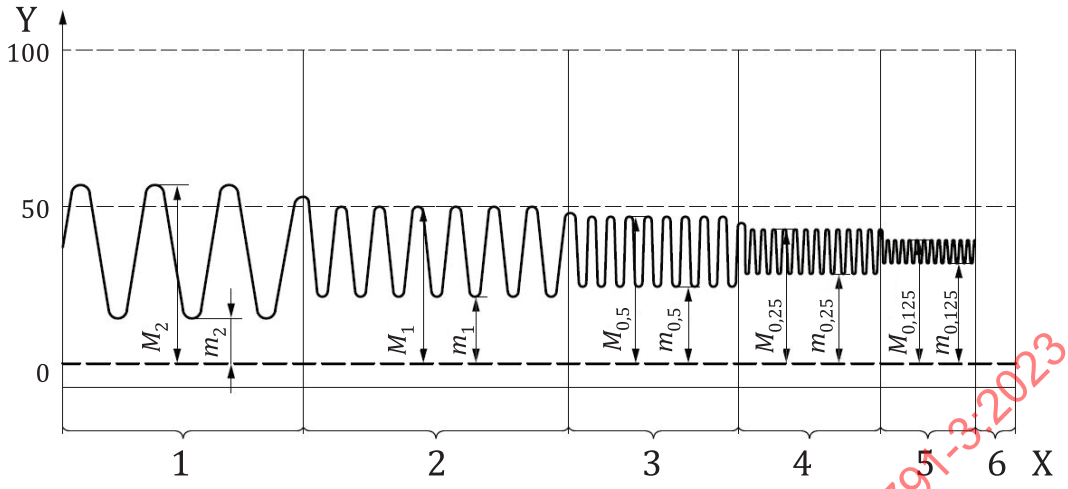
where

$C(n)$ 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 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.



Key

X	group
Y	relative light intensity
M_n	maximum relative intensity at n (mm) of optical mask line width
m_n	minimum relative 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 lines each 1,0 mm in width

Figure 4 — Example of the received relative light intensity of a specimen (see ISO 17221)

For photographic prints, two directions of measurement, horizontal and vertical directions of the sample, are required. Each value of the two directions shall be reported as well as the average of two directions.

Within the five measuring conditions of optical mask width, 0,125 mm, 0,25 mm, 0,5 mm, 1,0 mm and 2,0 mm in ISO 17221, the mask width of 2,0 mm is recommended for photographic prints which have a wide variety of surfaces[8].

8 Test report

The following items shall be reported:

a) a reference to this document, i.e. ISO/TS 20791-3:2023;

b) identify the materials used for making the print for testing, including the product IDs of the colorants and the product ID of the substrate media;

c) printing system; printer model and printer driver setting;

d) test target; applied patches, for examples, white (D_{min}), black, cyan, magenta, yellow, red, green and blue;

e) special notes for specimens; post-cutting of print, backing material if applied;

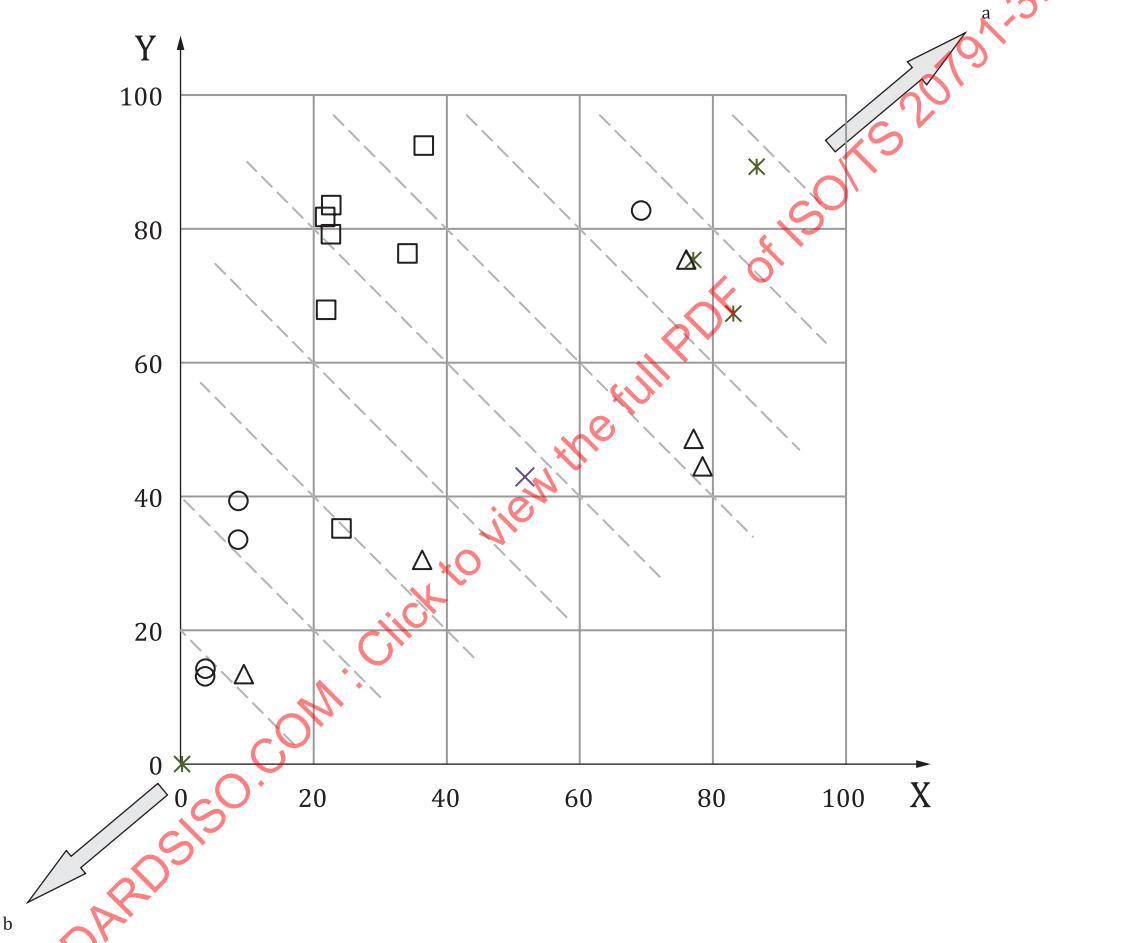
f) conditions and results of specular gloss; applied angle and measured value for each patch;

g) conditions and results of image clarity; applied angle, optical mask width and measured value for each patch.

In addition to tabular reporting, it is recommended to create a scatter plot of gloss mapping with two axes, specular gloss and image clarity, as shown in Figure 5, as it helps to characterize and understand the feature of samples[8].

NOTE 1 The mapping diagram of specular gloss and image clarity, as shown in Figure 5, can explain why dye-based inkjet prints printed on porous media look glossy even though specular gloss is generally low.

NOTE 2 Reference [8] describes that a linear combination of the two properties corresponds well with higher or lower perceived glossiness. The upper right direction in Figure 5 indicates higher glossiness and the lower left direction indicates lower glossiness, but they do not express superiorities or inferiorities because the preferred glossiness depends on the application.



Key

X	specular gloss (20°)
Y	image clarity (mask line width = 2 mm)
a	Higher glossiness.
b	Lower glossiness.
✳	silver halide
□	dye-based inkjet
△	pigment-based inkjet
×	thermal dye transfer
○	electrophotography

Figure 5 — Example of the scatter diagram representing gloss properties for black images