INTERNATIONAL STANDARD

ISO 11479-2

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Glass in building — Coated glass —

Part 2:
Colour of façade

Verre dans la construction — Verre à couche — Partie 2: Couleur des façades

Reference number
ISO 11479-2:2011(E)

Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 11479-2 was prepared by Technical Committee ISO/TC 160, *Glass in building*, Subcommittee SC 1, *Product considerations*.

ISO 11479 consists of the following parts, under the general title *Glass in building — Coated glass*:

— *Part 1: Physical defects*

— *Part 2: Colour of façade*

Introduction

It is known that façades incorporating coated glass can present different shades of the same colour, an effect that can be amplified when observed under an angle. Possible causes of differences in colour include slight variations in the colour of the substrate onto which the coating is applied and slight variations in thickness of the coating itself. Furthermore, for highly selective coatings, a slight variation in thickness can create a difference in colour, visible due to the high sensitivity of the human eye.

The purpose of this International Standard is to avoid any subjective approaches that might have been used in the past. This is achieved through the use of spectroscopic techniques and defined evaluation practices.

All measured values concern the finished glass product as installed in the façade and not the single components.

Glass in building — Coated glass —

Part 2:
Colour of façade

1 Scope

This part of ISO 11479 specifies a method for objective evaluation of the colour of coated glass when used in façades and viewed from the outside, as well as for measuring colour differences within the same glass pane and between two adjacent panes in the same façade. This part of ISO 11479 does not specify requirements for determining colour differences of transmitted colour as viewed from the inside or outside of a façade, nor for internal reflected colour. The comparison should only be undertaken for panes of the same glass type, composition and interior conditions and situated in the same plane of a façade.

Specific requirements are given for coated glass, dependent upon its light transmittance and reflectance.

This part of ISO 11479 is not applicable to curved or bent glass, which is specifically excluded for technical reasons.

NOTE Information on the perception, quantification and measurement of colour is given in Annex A.

2 Symbols

NOTE The following symbols form part of the colour measurement system used in this part of ISO 11479, which is based on ISO 11664-4:2008 (CIE S 014-4/E:2007).

2.1
L^*
lightness assuming a value between 0 and 100

NOTE $L^* = 0$ is black, $L^* = 100$ is white.

2.2
a^*
colour definition between green and magenta

NOTE Negative a^* is green, positive a^* is red.

2.3
b^*
colour definition between blue and yellow

NOTE Negative b^* is blue, positive b^* is yellow.

2.4
ΔE_{ab}^*
Euclidean distance between the points representing two colours in the CIE $L^*a^*b^*$ colour space

3 *In situ* colour measurement

The following paragraphs explain the procedures used on site for measuring the colour of the glass product.

Information on the perception, quantification and measurement of colour is given in Annex A.

3.1 Colour differences within the same glass pane

For colour differences within the same glass pane, the parameters L^*, a^* and b^* shall be measured with a portable colorimeter or spectrophotometer. The measurements shall be undertaken at a minimum of three points in each zone representing the colour difference.

NOTE 1 An example is illustrated in Figure 1.

Measurements shall not be undertaken at any point within 10 cm of an edge due to the potential for colour near the edge to differ slightly from the colour in the centre. However, for glass coated as fixed dimensions, measurements shall not be undertaken nearer than 15 cm from an edge.

NOTE 2 Measurements can be affected by the proximity of the frame and the edge of the insulating glass unit.

The ΔL^*, Δa^*, Δb^* and $\Delta E_{ab}{}^*$ values shall be calculated based on the difference between the average values for each zone, in accordance with Equations (1), (2), (3) and (4), respectively.

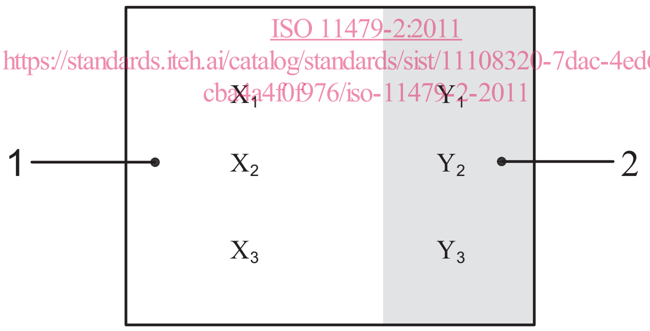
$$\Delta L^* = L^*_{(\text{zone 2})} - L^*_{(\text{zone 1})} \tag{1}$$

$$\Delta a^* = a^*_{(\text{zone 2})} - a^*_{(\text{zone 1})} \tag{2}$$

$$\Delta b^* = b^*_{(\text{zone 2})} - b^*_{(\text{zone 1})} \tag{3}$$

$$\Delta E^*_{ab} = \sqrt{\left(\Delta L^*\right)^2 + \left(\Delta a^*\right)^2 + \left(\Delta b^*\right)^2} \tag{4}$$

The values of ΔL^*, Δa^* and Δb^* shall meet the requirements given in 3.3.



Key

1 zone 1

2 zone 2

Figure 1 — Example of measurements undertaken at a minimum of three points in each zone representing the colour difference

3.2 Colour differences between two adjacent panes in the same façade

The comparison should only be undertaken for panes of the same glass type, composition and interior conditions and situated in the same plane of a façade.

NOTE 1 Interior refers to the ambient lighting inside the building.

NOTE 2 The reference pane can be compared with any of the eight adjacent panes, horizontal, vertical and diagonal.

For colour differences between two adjacent panes, the parameters L^*, a^* and b^* shall be measured with a portable colorimeter or spectrophotometer. For each pane representing the colour difference, the measurements shall be undertaken at a minimum of three points, e.g. along a diagonal.

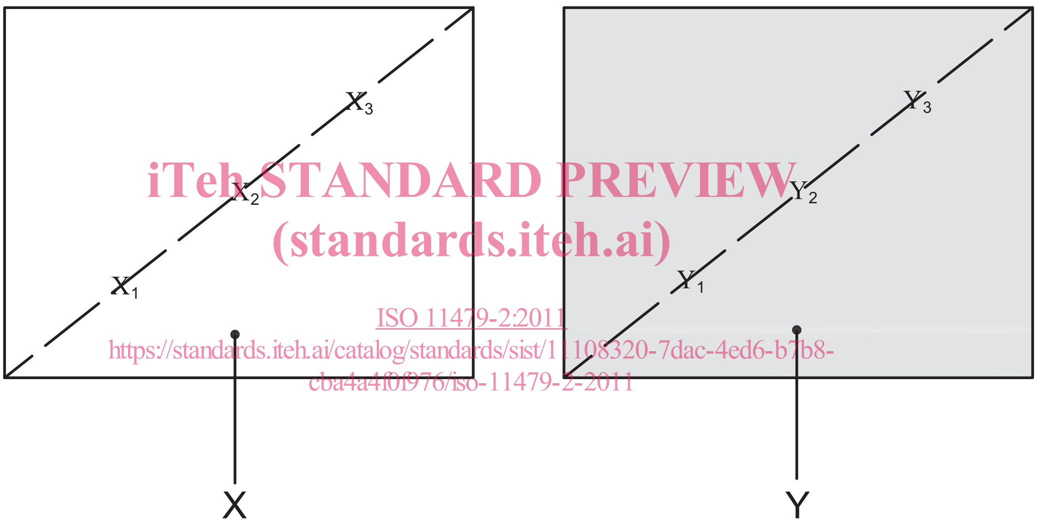
NOTE 3 An example is illustrated in Figure 2.

The average values of L^*, a^* and b^* shall be determined for each pane.

NOTE 4 An example is detailed in Table 1.

Table 1 — Example of determining the average values of L^*, a^* and b^* for one pane, e.g. Y

Pane Y	L^*	a^*	b^*
Measuring point Y_1	L^*_{Y1}	a^*_{Y1}	b^*_{Y1}
Measuring point Y_2	L^*_{Y2}	a^*_{Y2}	b^*_{Y2}
Measuring point Y_3	L^*_{Y3}	a^*_{Y3}	b^*_{Y3}
Average	$L^*_{\text{pane Y}} = (L^*_{Y1} + L^*_{Y2} + L^*_{Y3})/3$	$a^*_{\text{pane Y}} = (a^*_{Y1} + a^*_{Y2} + a^*_{Y3})/3$	$b^*_{\text{pane Y}} = (b^*_{Y1} + b^*_{Y2} + b^*_{Y3})/3$



Key

X pane X

Y pane Y

Figure 2 — Example of measurements undertaken at a minimum of three points for each pane representing the colour difference

The ΔL^*, Δa^* and Δb^* values shall be calculated based on the difference between the average values for each pane, in accordance with Equations (5), (6) and (7), respectively.

$$\Delta L^* = L^*_{(\text{pane Y})} - L^*_{(\text{pane X})} \tag{5}$$

$$\Delta a^* = a^*_{(\text{pane Y})} - a^*_{(\text{pane X})} \tag{6}$$

$$\Delta b^* = b^*_{(\text{pane Y})} - b^*_{(\text{pane X})} \tag{7}$$

where X is the reference pane.

The values of ΔL^*, Δa^* and Δb^* shall meet the requirements given in 3.3.

The value of ΔE_{ab}* shall be calculated from the ΔL*, Δa* and Δb* values calculated from Equations (5), (6) and (7) using Equation (4).

3.3 Requirements for colour

The values of ΔL*, Δa*, Δb* and ΔE_{ab}* are determined in accordance with 3.1 and 3.2 and shall meet the requirements given in Table 2.

Table 2 — Requirements for colour

ΔL*	≤5,0
Δa*	≤5,0
Δb*	≤5,0
ΔE_{ab}*	≤6,0

3.4 Angle dependency of colour

The colour of solar-control glass, particularly that with a high selectivity, varies with the angle of observation. These variations can only be measured in a laboratory on small samples and shall not be undertaken *in situ*. Therefore, this part of ISO 11479 reflects colour measurements at normal incidence angles only.

Annex A
(informative)

Perception, quantification and measurement of colour

A.1 Perception of colour

The perception of colour can be very subjective and linked to the impression and perception of the individual, the sensitivity of the eye being a very personal characteristic.

A variety of conditions affect how a colour looks, for instance when observing the façade of a building from the outside, including:

— luminosity, e.g. a dark overcast sky might reveal colour differences not observed under direct sunlight;

— distance and angle of observation;

— type and colour of mullions and transoms used in the façade;

— distance between two adjacent glass panes;

— the eye of the observer;

— internal conditions, e.g. the absence of lighting in the building, i.e. dark background, may increase the perception of colour differences;

— external conditions, e.g. the presence of other buildings that may be reflected by the glass.

Care should be taken to avoid observing the façade under conditions which are not representative for a building "in use". Alternatively, due account should be taken of these factors during the assessment.

A.2 Quantification of colour

As noted in A.1, a visual observation of colour invariably has a subjective element. Therefore, it is very important to be able to quantify the colour of a façade in order to develop an approach that is independent of this subjectivity. Various methods have been devised in the past for quantifying colour and expressing it numerically with the aim of making it easier and more accurate.

The method used in this part of ISO 11479 is the $L^*a^*b^*$ colour space, defined by the CIE in 1976. As the colour of an object is dependent upon the light source, the standard illuminant adopted by this part of ISO 11479 is D65 (representing average daylight) and the angle of observation is 10°.

The $L^*a^*b^*$ colour space (also referred to as CIELAB) is one of the most popular colour spaces for measuring object colour and is widely used in a variety of fields. It provides a procedure for evaluating uniform colour differences in relation to visual differences and, moreover, it enables colour to be quantified.

This colorimetric system can be visualized by a three-dimensional colour space, where every colour can be represented by a set of three coordinates: L^*, a^* and b^*, where L^* indicates the lightness and a^* and b^* the chromaticity coordinates. Positive values of a^* show the red direction, and negative values the green direction, whereas positive values of b^* show the yellow direction and negative values the blue direction. The centre is achromatic, i.e. neutral.

NOTE The parameters L^*, a^* and b^* can be used for quantifying the aesthetics of a façade, observed from the outside (in reflection), or to characterize the properties of light transmission through a glass pane.