

# ConverLight® Dynamic Glass

## Technical Product Specification

### ConverLight65

This document is intended to describe the product ConverLight65 Dynamic Glass. Technical aspects of the product are addressed in detail.



## Performance

Every batch of material used for ConverLight® Dynamic Glass is tested at ChromoGenics to ensure its electrochromic performance meets the requirements. Specifications of requirements during the product lifetime are shown below. For a detailed description on how tests are performed to represent 20 years of service life, see section *Internal validation*.

### Optical transmittance range

|                                                           |                                    |
|-----------------------------------------------------------|------------------------------------|
| Range at delivery (LT <sub>max</sub> -LT <sub>min</sub> ) | 65-22% ( ±3%)                      |
| Accepted ageing after 10 years of service life            | 3.5% - units loss of transmittance |
| Accepted ageing after 20 years of service life            | 7% - units loss of transmittance   |

### Switch speed

The switch speed depends on glass width but is typically around 20 minutes.

### Uniformity

|                          |                                                                                                                            |
|--------------------------|----------------------------------------------------------------------------------------------------------------------------|
| Transmittance uniformity | No visible variations (<5%) at completed switch                                                                            |
| Color uniformity         | Color coordinates within specification over entire Dynamic Glass<br><i>For specification see section Color Coordinates</i> |
| Haze                     | No appreciable haze, corresponding to < 2%                                                                                 |

### Mechanical Defects

|                    |                                                                       |
|--------------------|-----------------------------------------------------------------------|
| Distortion         | No appreciable distortion. Measured according to ISO 12543-6.         |
| Mechanical defects | No appreciable mechanical defects. Measured according to ISO 12543-6. |

### Edges

The edge area is defined as a 25 mm wide frame along the glass edge. In this area there are no requirements for performance or defects.

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## Foil deformations

During glass lamination minor deformations can occur in the ConverLight® foil. Sometimes these can be observed when viewing the glass in reflection, from certain angles from the outside. If the foil deforms during the glass lamination, a certain waviness may occur. In other cases, more local deformations can occur. The deformations have no effect on the durability of the product. Deformations that are only visible in reflection and when viewed from certain angles are approved by ChromoGenics internal quality controls and are not grounds for complaint nor reclamation.

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## Optical defects in the field of view

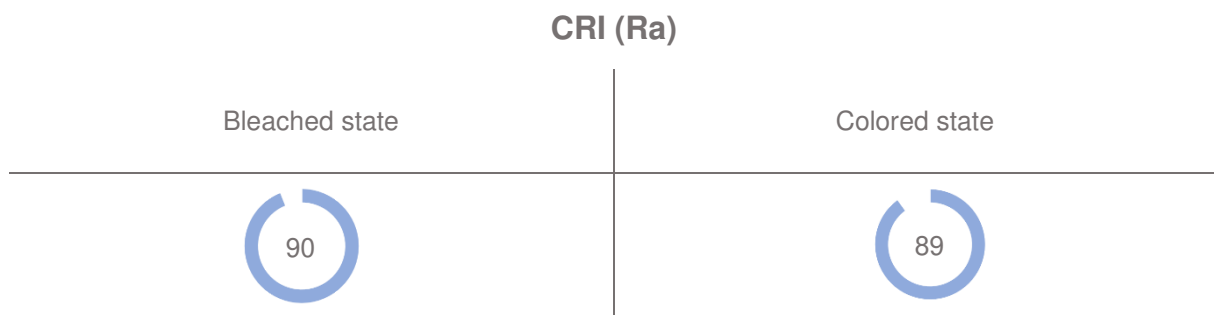
When laminated glass is inspected at the factory, the method described in EN 12543-6 applies. When assessing glass that has been installed, normal viewing distance and normal daylight conditions shall apply. By normal viewing distance, it refers to the distance that applies in the specific case, or as specified in industry guidelines, typically 3 meters and perpendicular to the glass. An example where a greater distance is applied during the assessment is glass roofs. By normal daylight, it refers to a day with diffuse light, meaning without direct sunlight or any other light source entering at an abnormal angle to the glass and amplifying any imperfections. The use of lamps or magnifying aids is not allowed, nor is it permissible to detect defects up close and mark them so that they become visible from the normal viewing distance.

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## Color coordinates

The color rendering index (CRI) for glass indicates how different colors of objects behind the glass will be rendered compared to objects under natural daylight. ConverLight65 has a high CRI in all states.

In reflection, color variation may be visible.



The color coordinates of a ConverLight65 glass in its bleached state are shown in Figure 1. The allowed color coordinates in both transmission and reflection of ConverLight65 are within the red rectangle in Figure 1.

Color coordinates are within specification over the entire Dynamic Glass. Due to the inherent properties of electrochromic technology, minor variations in color uniformity may occur, especially when glazing is viewed at an angle or under certain lighting conditions. The perceived color uniformity can depend on environmental factors such as sky conditions, light intensity, and the observer's position.

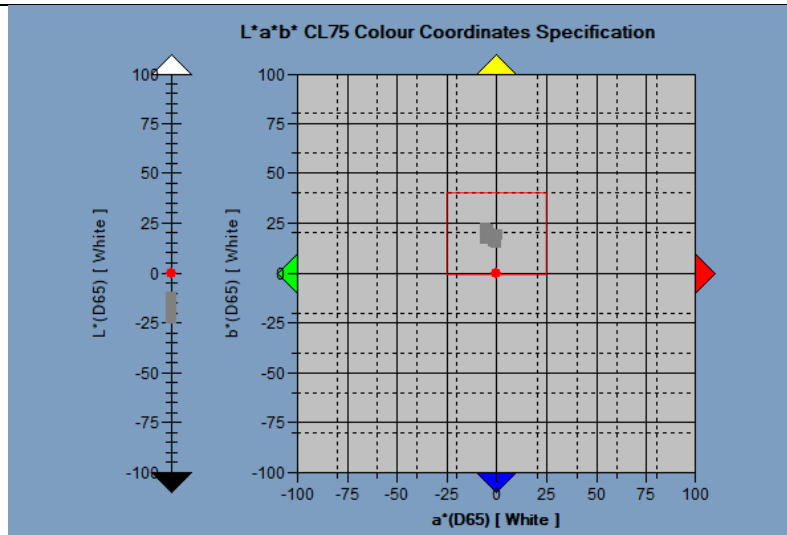


Figure 1: CL65 Color coordinates specification in transmission and reflection. Grey dots are color coordinates in transmission measured in the bleached state according to CIE  $L^*a^*b$  coordinate system.

## External validation

The sound reducing properties of ConverLight® Dynamic Glass have been tested externally.

### EN ISO 10140-2

|                |                                        |
|----------------|----------------------------------------|
| Test           | Sound reduction                        |
| Test institute | RISE                                   |
| Result         | $R_w(C; Ctr) = 35 (-1; -3) \text{ dB}$ |

ConverLight® Dynamic Glass has been tested for durability and mechanical strength according to international standards for laminated glass.

### External tests

| Test standard  | Property                         | Result   | Test institute |
|----------------|----------------------------------|----------|----------------|
| EN ISO 12543-4 | High UV irradiation              | Approved | Ift Rosenheim  |
| EN ISO 12543-4 | High temperature                 | Approved | KIWA           |
| EN ISO 12543-4 | High humidity                    | Approved | KIWA           |
| EN 356         | Vandalism and burglar resistance | P4A      | RISE           |
| EN 12600       | Pendulum body impact resistance  | 1(B)1    | RISE           |

## Internal validation

ConverLight® Dynamic Glass is thoroughly tested at ChromoGenics to ensure its electrochromic performance meets the requirements. The tests performed at ChromoGenics are described in the following sections.

The test matrix used is based on internally developed tests and international test standards (ASTM standards). Internal tests are accelerated tests developed to represent at least 20 years of service life. The internal tests have been developed in consultation with experts in lifetime tests for electrochemical systems (e.g. batteries).

### Internal tests

Tests represent at least 20 years of service life.<sup>1</sup>

| Test                       | Test conditions            | % of switching range | Temperature | Comments                          |
|----------------------------|----------------------------|----------------------|-------------|-----------------------------------|
| Cycling test <sup>2</sup>  | Long-term operation, 6000c | 80%                  | 22°C        | Accelerated aging test            |
|                            | Mid-term operation, 1000c  | 120%                 | 65°C        | Accelerated aging test            |
|                            | Mid-term operation, 3000c  | 100%                 | 65°C        | Accelerated aging test            |
|                            | Long-term operation, 6000c | 80%                  | 65°C        | Accelerated aging test            |
|                            | Short-term operation, 200c | 80%                  | -20°C       | Function test extreme temperature |
|                            | Short-term operation, 200c | 80%                  | 85°C        | Function test extreme temperature |
| Calendar test <sup>3</sup> | Long-term storage, 4400h   |                      | 80°C        | Accelerated aging test            |

<sup>1</sup> Defined as defect-free and performance >80%.

<sup>2</sup> Rapidly switching between light and dark states continually.

<sup>3</sup> After storage in extreme temperature, the function is tested to verify that 80% of original performance remains.

Any questions, please contact ChromoGenics.