

SageGlass®

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## ACHIEVING NEUTRAL COLOUR RENDERING IN SPACES GLAZED WITH SAGEGLASS

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Meeting Room - Vetrotech Saint-Gobain International HQ – Flamatt, Switzerland



SageGlass Europe & Middle East

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## What are the good practices for lighting for visual comfort and performance?

Quantity of illumination, characterised by illuminance levels, is essential to visual performance. Uniformity of brightness distribution, control of glare and reflections are also major quality criteria to consider in terms of the lighting environment.

Besides those aspects, colour rendering and the colour appearance of light are also of high importance to ensure a comfortable visual environment. These factors are also key to defining the atmosphere of a space. According to the European standard EN 12464-1, “It is important for visual performance and the feeling of comfort and wellbeing that colours in the environment, of objects and of human skin are rendered naturally, correctly and in a way that makes people look attractive and healthy”.

Colour aspects can be described by two common indicators: the correlated colour temperature (CCT) and the colour rendering index (CRI).

## How to achieve neutral colour rendering with SageGlass

Light in a room glazed with SageGlass can be maintained with an essentially neutral colour rendition by **effectively zoning and controlling the glass**.

This has been demonstrated through a study conducted by Professor John Mardaljevic at Loughborough University in the UK in 2014. A short biography and a summary of this work can be found in the references at the end of this document.

Colour temperature and colour rendering measurements were taken on a sunny day at several locations within a room equipped with SageGlass set to varying tint levels: fully tinted, partially tinted or completely clear. In parallel, measurements in rooms glazed with standard clear glass in overcast conditions were also taken as a reference.

The average **colour rendering index measured was 93 and the mean colour temperature 4970K**. It revealed that the daylight illumination is actually less “blue” than the overcast sky daylight spectra through ordinary clear glass. The main results are displayed in the table on the right:

The table below gives recommended lower limit values for different types of workplaces and activities:

Type of interior, task or activity	E (lux)	CRI
<b>Offices</b>		
Writing, typing, reading	500	80
Conference and meeting	500	80
<b>Retail</b>		
Sales area	300	80
<b>Educational buildings</b>		
Classrooms	300	80
<b>Healthcare premises</b>		
– <b>Examination rooms</b>		
General lighting	500	90
Examination and treatment	1000	90
– <b>Intensive care unit</b>		
Simple examinations	300	90
Examination and treatment	1000	90
– <b>Treatment rooms (general)</b>		
Dermatology	500	90
Dialysis	500	80

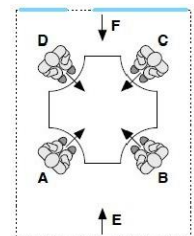
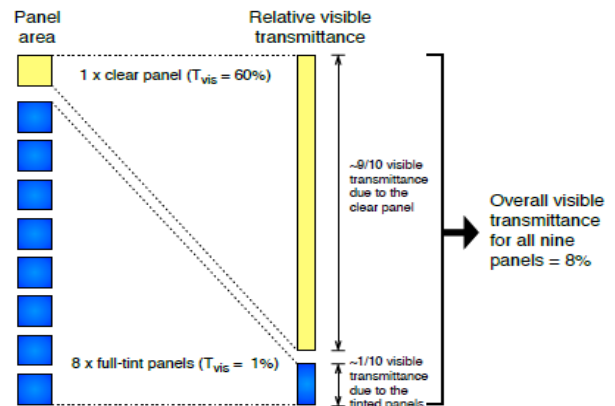


Figure 1: Views inside an office glazed with SageGlass. Three out of eight panes (40%) are in the clear state and five of eight panes (60%) are in the fully tinted state. The light appears essentially neutral.




SageGlass glazing configuration	Measured mean CCT	Measured mean CRI
<b>40% (3 panes) fully clear</b> <b>60% (5 panes) at 20%T</b> 	5211 K	92
<b>40% (3 panes) fully clear</b> <b>60% (5 panes) at 6%T</b> 	5243 K	93
<b>40% (3 panes) fully clear</b> <b>60% (5 panes) fully tinted</b> 	4970 K	93
<b>13% (1 pane) fully clear</b>  <b>87% (7 panes) fully tinted</b>	4800 K	94

These measurements show that neutral colour rendering can be maintained by keeping approximately **10-15%** of the glass area in the **clear state** whilst the other panes are tinted appropriately to provide the required level of heat gain and glare control.

This can be explained by the fact that the zone in the clear state is responsible for the majority of the light entering the space, since it transmits 60% of the light, while the tinted state only transmits 1%. Since light passing through the clear state remains essentially neutral, assuming good light mixing, the overall illumination of the space appears neutral.



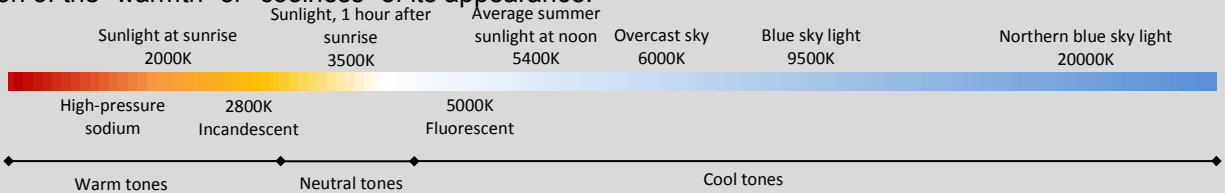
We see this phenomenon replicated in many other spaces glazed with SageGlass. In the appendix below, there are a number of images of interior spaces that demonstrate good colour rendering with a significant portion of the glass in a tinted state, and some in the fully clear state.

Reference clear glazing	Measured mean CCT	Measured mean CRI
	6468 K	88
	7080 K	96
	6803 K	87

## Glossary

**Illuminance:** indicates the amount of luminous flux from a light source that falls on a given surface, and is measured in Lux.

**CCT:** the apparent colour of the light emitted by a source, relative to the colour appearance of the light from an ideal incandescent source when heated to a particular temperature, measured in degrees Kelvin (K). It gives an indication of the “warmth” or “coolness” of its appearance.



**CRI:** measures the ability of a light source to illuminate objects “correctly”, so they appear “natural”. The maximum value of Ra is 100, and applies to daylight and some incandescent light sources considered as reference light sources. For reference, lighting designers consider colour rendering indices above 90 to be essentially neutral, and the best fluorescent lights have a CRI of 85.

Light Source	CRI
Daylight	100
Incandescent and tungsten halogen	90-100
Fluorescent	60-90
Standard metal halide	60-70
High-pressure sodium	20-30

## About John Mardaljevic

John Mardaljevic is Professor of Building Daylight Modelling at the School of Civil & Building Engineering, Loughborough University, in the UK. He pioneered what is now known as Climate-Based Daylight Modelling (CBDM), which is becoming a worldwide industry practice. Today he is the acknowledged global expert in daylight, contributing his expertise within active standardisation work at national and European levels. He also acts as a consultant for major projects, as he did for the New York Times Building and The State Hermitage Museum in St Petersburg. In 2012, the Society of Light and Lighting (SLL) presented him with its prestigious Lighting Award.

## References

- [1] John Mardaljevic, [How to maintain a neutral daylight illumination with SageGlass EC Glazing](#),
- [2] J. Mardaljevic, R. Kelly Waskett, B. Painter, Neutral daylight illumination with variable transmission glass: Theory and Validation. Accepted for publication in Lighting Research and Technology in 2014.
- [3] J. Mardaljevic, [Electrochromic/Tinted Glazing. Modelling the Illumination Spectrum](#), 13th International Radiance Workshop 2014, London, UK.