

## ChromoGenics Dynamic Glass, Performance, Test and Durability

This document is intended to inform the customer of the methods, tests and results performed to demonstrate ChromoGenics Dynamic Glass performance and durability.

### DEFINITION CHROMOGENICS DYNAMIC GLASS

All Dynamic Glass contains at least one glass laminate with Dynamic Foil laminated between two glasses, and where the Dynamic Foil is the part containing the dynamic (electrochromic) function. Dynamic Glass can either be a simple glass laminate or an insulating glass. From Dynamic Glass, there is always a cable that is connected to a control system for automation.

### OPTIC AND THERMAL PROPERTIES

To determine ChromoGenics Dynamic Glass optic and thermal properties, its spectral properties are measured to then calculate the optic and thermal properties for the different glass configurations.

Internal measurements and calculations		
Property	Method	Comment
Light Transmission (LT)	Spectral measurements and LBNL Window 7.7 calculations	EN410
Light Reflection (LR)	Spectral measurements and LBNL Window 7.7 calculations	EN410
Color (Ra)	Spectral measurements and LBNL Optics 6 calculations	EN410
Solar Transmission (ST)	Spectral measurements and LBNL Window 7.7 calculations	EN410
Solar-Energy Transmission (g)	Spectral measurements and LBNL Window 7.7 calculations	EN410
Thermal data ( $U_g$ )	Spectral measurements and LBNL Window 7.7 calculations	EN673
Solar Transmission in 60° angle ( $ST_{60}$ )	Spectral measurements and LBNL Window 7.7 calculations	EN410
Solar-Energy Transmission in 60° angle ( $g_{60}$ )	Spectral measurements and LBNL Window 7.7 calculations	EN410

## DYNAMIC (ELECTROCHROMIC) FUNCTION

The test matrix used to evaluate ChromoGenics Dynamic (Electrochromic) function is based on internally developed tests and international test standards (ISO standards). Internal tests are accelerated tests developed to show 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, >20 years of service life <sup>1</sup>				
Test	Test conditions	Temperature	Result	Comments
Cycling test <sup>2</sup>	Long-term operation, 6 000c, 80%	22°C	Approved	Accelerated aging test
	Mid-term operation, 1000c, 120%	65°C	Approved	Accelerated aging test
	Mid-term operation, , 3000c , 100%	65°C	Approved	Accelerated aging test
	Long-term operation, 6000c , 80%	65°C	Approved	Accelerated aging test
	Short-term operation , 200c, 80%	-20°C	Approved	Functional test extreme temperature
	Short-term operation, 200c, 80%	85°C	Approved	Functional test extreme temperature
Calendar test <sup>3</sup>	Long-term storage , 4400h	80°C	Approved	Accelerated aging test
	Short-term storage, 2.5h	-40°C	Approved	Storage at extreme temperatures
	Short-term storage, 2.5h	130°C	Approved	Storage at extreme temperatures
Field test <sup>4</sup>	North Africa		4 yr <sup>5</sup>	Accelerated aging tests in real-life outdoor conditions

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

<sup>2</sup> Quickly moving between light and dark mode repeatedly.

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

<sup>4</sup> Exposed to real conditions in Morocco, i.e. placed outdoors in 5°, 45° and 90° angle to the southwest and cycling once a day.

<sup>5</sup> Field test completed after 4 years. To be restarted with electrochromic material from ChromoGenics' own sputter system

International testing standards, >20 years of service life				
Test	Test conditions	Result	Comments	Test institute
ISO 18543:2021	Cycling under UV radiation (1 sun) BBT1 65 ° C, 30,000c	30 000c	Accelerated aging test for electrochromic glass	RISE

<sup>1</sup> Black Body Temperature

## MECHANICAL STRENGTH (SAFETY AND SECURITY)

ChromoGenics Dynamic Glass mechanical strength and durability are tested according to international standards for laminated safety and security glass.

External tests			
Test	Property	Result	Test institute
EN ISO 12543-4	High UV irradiation	Approved	RISE-SP
EN ISO 12543-4	High temperature	Approved	KIWA
EN ISO 12543-4	High humidity	Approved	KIWA
EN ISO 12600	Heavy shock	1(B)1	RISE-SP
EN ISO 356	Burglary	P4A	RISE-SP
EN ISO 1288-3	Bending strength	490N / 21.8MPa	RISE-SP

## Sound:

ChromoGenics Dynamic Glass sound reducing properties have been tested externally at RISE-SP.

External tests			
Test	Property	Result	Test institute
EN ISO 10140-2	Sound reduction	Rw=35dB	RISE-SP

## Fire:

ChromoGenics Dynamic Glass has not yet been tested for fire protection properties.

External tests			
Test	Property	Result	Test institute
EN13501		-	-

For questions, please contact ChromoGenics.