English

Structural and security glazing interlayers

Bulletin

Trosifol® Extra Stiff Pro: Next-generation high stiffness PVB film



kuraray

Trosifol®

Trosifol® Extra Stiff Pro has the best structural capacity properties of any PVB interlayer available

For high-performance and demanding structural glazing projects, architects, designers and engineers have, over recent years, only had access to a limited choice of interlayers. But the introduction of Trosifol® Extra Stiff Pro offers a new alternative, with improved structural properties enabling more design freedom in structural glazing applications. No other PVB interlayer can offer this level of performance.



Photo: © papmap / shutterstock.com

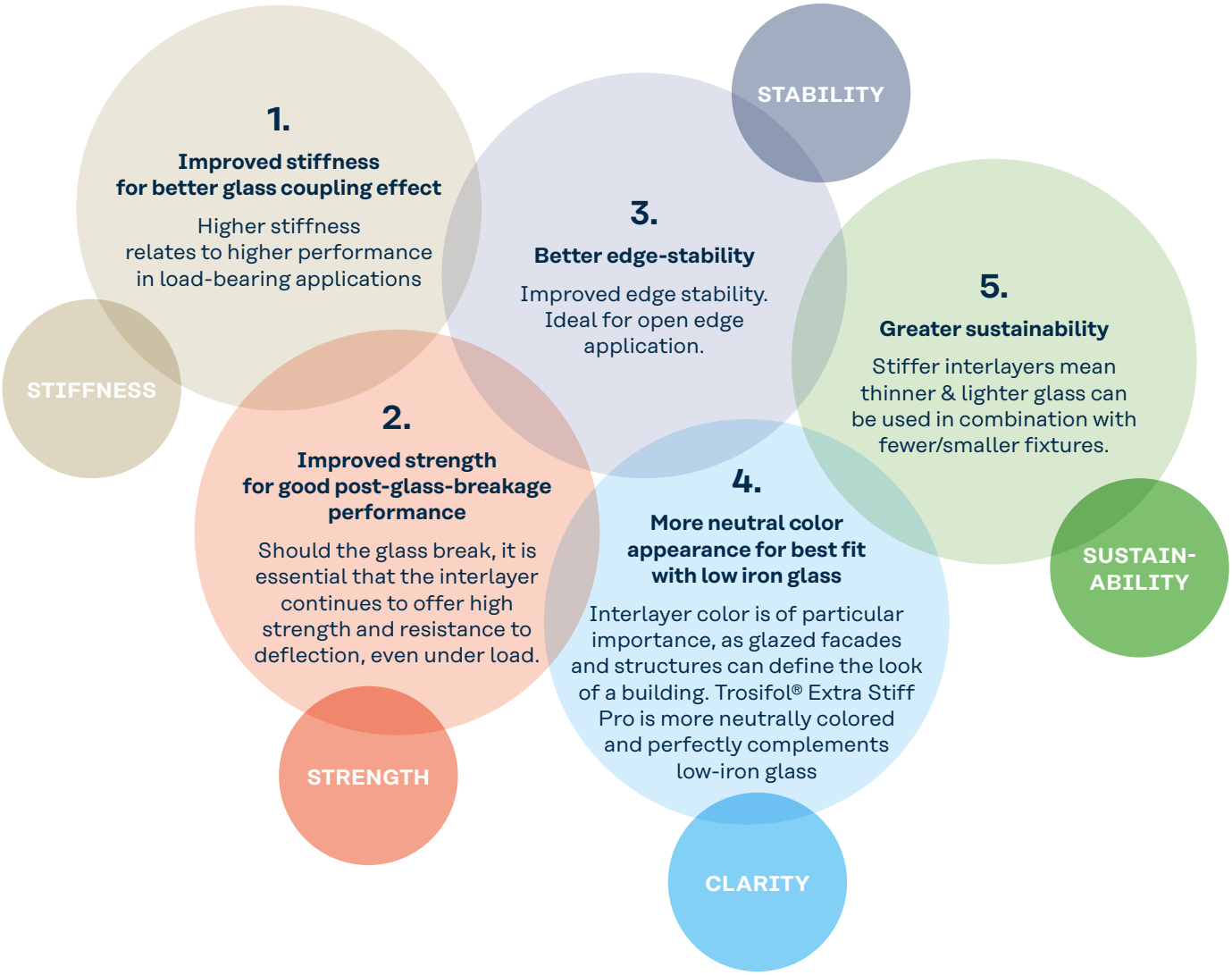
GLASS PANELS HAVE GONE FAR beyond their original architectural scope of light transmittance and aesthetics. Thanks to advances in chemistry, physics and testing of interlayer formulations, glass is seeing almost exponential growth in its deployment in a structural capacity, unleashing significant functional and aesthetic design freedoms for architects and building owners.

By amplifying and optimizing the coupling effect, newer interlayers increase the strength and load-bearing capabilities of glass laminates, compared to plain glass of the same thickness. Indeed, laminated panels can often be fabricated both thinner and lighter compared to their plan-glass equivalents.

However, for more demanding applications, the choice of interlayers has been restrictive, with very few offering the higher performance and safety levels required – in relation to their stiffness and post-breakage performance – for overhead applications.

New Trosifol® Extra Stiff Pro offers the best structural capacity of any PVB interlayer.

Kuraray brings together many impressive performance parameters, which, in combination, place it in a perfect position within the product portfolio. Trosifol® Extra Stiff Pro offers the many performance advantages over current commercially available structural PVB interlayers.



Physical properties

Trosifol® Extra Stiff Pro*

Type	Adhesion	Film thickness [mm]	[mil]	Color	Light transmittance*1 [%]	UV transmittance*1 [%]	Solar absorption*1 [%]
Trosifol® Extra Stiff Pro	high	0.76	30	Clear	88	< 1	20

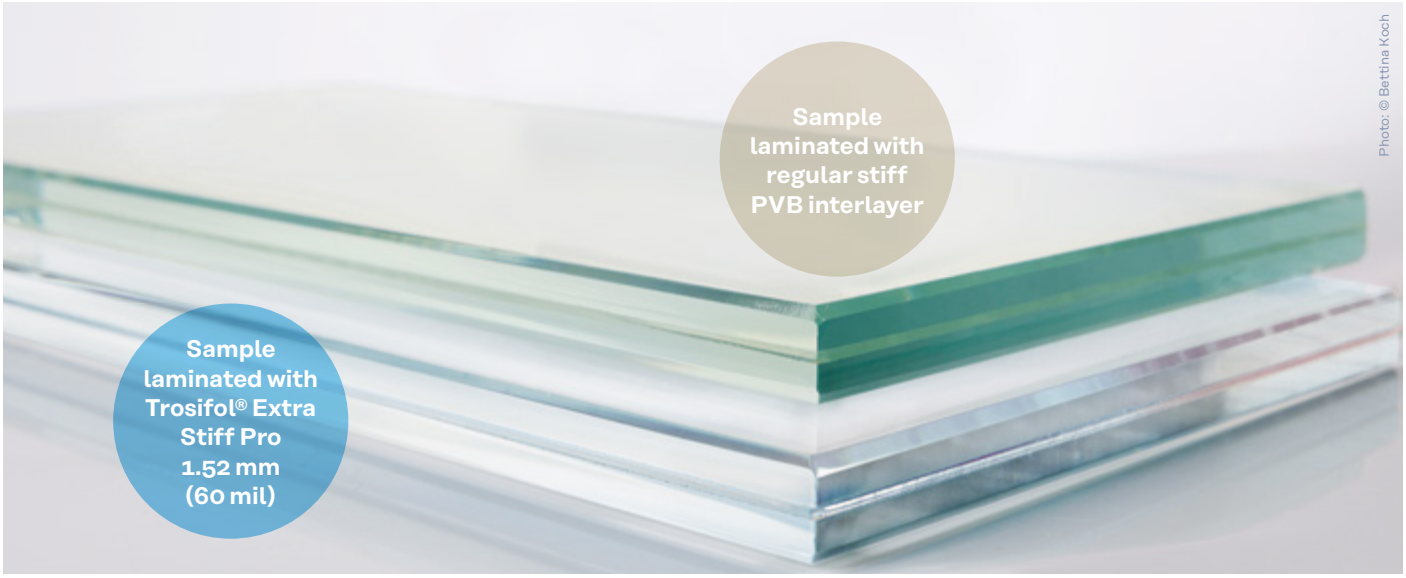
TAB 1 * LSG with 2 x 4 mm Floatglass according EN 410/ISO 9050 *1 Values calculated using Lawrence Berkeley National Laboratory Optics5 and Windows5 software. Not all products are available in all regions.

Property	Test method	Unit	Result
Density	DIN EN ISO 1183-1	g/cm³	1.08
Refractive index	DIN EN ISO 489	-	1.488
Thermal conductivity	DIN EN 993-15	W/mK	0.22
Thermal expansion coefficient	ISO 11359-2	1/K	1.2×10^{-4}
Specific heat capacity		J/g K	1.6
Surface resistivity	DIN 53482	Ω	$> 10^{12}$
Tensile strength	ISO 527-3	MPa (kpsi)	> 32
Elongation at break	ISO 527-3	%	> 170
Tg	DMA, 3K/min, 1 Hz	°C	50

TAB 2

COMPARISON IN CLARITY

Superior clarity and neutral color in combination with low iron glass



Structural comparison

EN 16613 HUMAN LINE LOAD CASE / NO CROWD LOAD

Dimension of the glazing panel: 1500 mm (w) x 1100 mm (h)
- Supported at the bottom edge in a glazing profile / cantilevered
- Vertical position / 90°

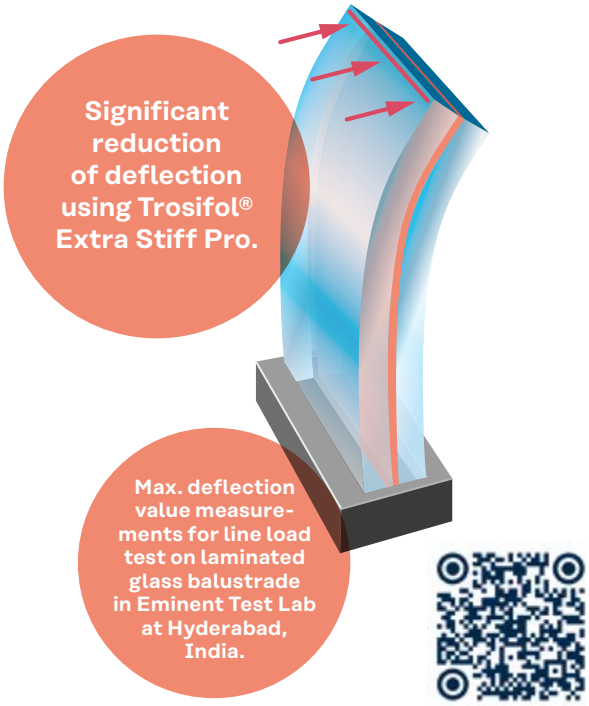
Laminate construction:
- 2 x 8 mm fully tempered glass + 1.52 mm interlayer

Line load of 1.50 KN/m at 30 °C for 30 seconds duration

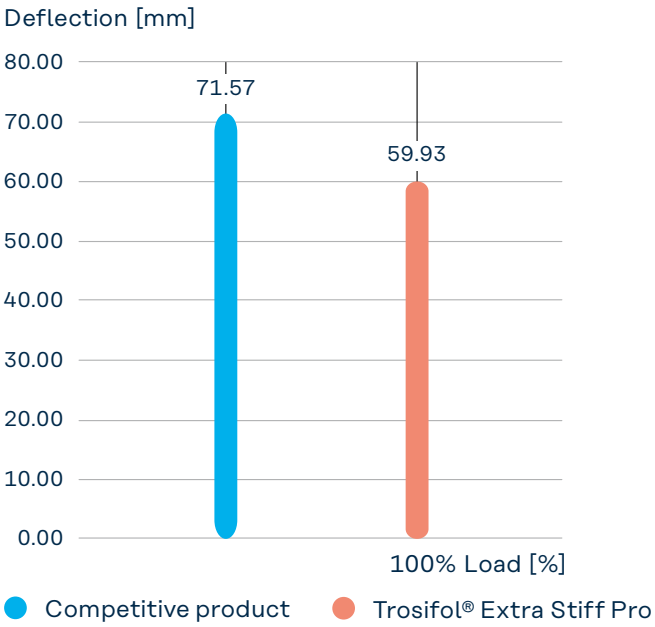
Trosifol® Extra Stiff Pro

Type	E(t)-Modulus [MPa]	Deflection [mm]	Comment
Trosifol® Extra Stiff Pro	12	10	super - very stiff
Competitor Stiff PVB	7.1	15.1	good
Standard PVB	1.2	22	weak

TAB 3 ➔



Deflection of Trosifol® ES Pro



The line load of 1.5 KN/m was applied at the top edge of cantilevered glass balustrade (1.1 x 1.5 mts.) to record the maximum deflection value at the top edge. The test was performed on 17.52 mm thick fully tempered (FT) laminated glass (8 mm FT + 1.52 interlayer + 8 mm FT) made with two interlayer types i.e. Trosifol® ES Pro & competitive product. Total six laminated glass specimens, three for each type of interlayer were tested. All specimens were conditioned at 30°C for 24 hrs. before the start of the test. The graph below shows the average deflection value at the top edge for three specimens for each sample type. The superior structural strength and stiffness of our Trosifol® Extra Stiff Pro is reflected by the lower deflection than of the competitive product.

Trosifol® Extra Stiff Pro – Shear Relaxation Modulus G(t) / MPa

Temperature	Load duration													
	1 sec	3 sec	5 sec	10 sec	30 sec	1 min	5 min	10 min	30 min	1 hour	6 hours	12 hours	1 day	2 days
10°C (50°F)	420	390	370	350	320	300	250	220	180	160	92	70	52	35
20°C (68°F)	340	310	290	270	230	205	150	120	83	63	23	14	7.5	4.3
25°C (77°F)	250	210	190	160	120	95	49	32	16	8.7	2.1	1.5	1.1	0.95
30°C (86°F)	120	82	67	49	25	16	4.1	2.4	1.3	1.0	0.78	0.73	0.69	0.65
35°C (95°F)	39	19	13	7.1	3.0	1.9	1.0	0.88	0.75	0.70	0.61	0.59	0.55	0.52
40°C (104°F)	10	4.1	2.7	1.6	1.1	0.85	0.69	0.66	0.60	0.57	0.47	0.44	0.41	0.37
50°C (122°F)	0.93	0.78	0.74	0.70	0.64	0.61	0.54	0.50	0.44	0.40	0.27	0.22	0.18	0.13
60°C (140°F)	0.66	0.60	0.58	0.55	0.49	0.45	0.35	0.30	0.22	0.18				
70°C (158°F)	0.55	0.49	0.46	0.42	0.35	0.30	0.18	0.14						

Trosifol® Extra Stiff Pro – Young Relaxation Modulus E(t) / MPa

Temperature	Load duration													
	1 sec	3 sec	5 sec	10 sec	30 sec	1 min	5 min	10 min	30 min	1 hour	6 hours	12 hours	1 day	2 days
10°C (50°F)	1240	1150	1090	1030	940	880	740	650	530	470	270	210	150	100
20°C (68°F)	1000	910	850	800	680	600	440	350	240	185	68	41	22	13
25°C (77°F)	740	620	560	470	350	280	140	94	47	26	6.2	4.4	3.2	2.8
30°C (86°F)	350	240	200	140	74	47	12	7.1	3.8	2.9	2.3	2.1	2.0	1.9
35°C (95°F)	120	56	38	21	8.8	5.6	2.9	2.6	2.2	2.1	1.8	1.7	1.6	1.5
40°C (104°F)	29	12	7.9	4.7	3.2	2.5	2.0	1.9	1.8	1.7	1.4	1.3	1.2	1.1
50°C (122°F)	2.7	2.3	2.2	2.1	1.9	1.8	1.6	1.5	1.3	1.2	0.79	0.65	0.53	0.38
60°C (140°F)	1.9	1.8	1.7	1.6	1.4	1.3	1.0	0.88	0.65	0.53				
70°C (158°F)	1.6	1.4	1.4	1.2	1.0	0.88	0.53	0.41						

5 days	1 week	3 weeks	1 month	1 year	10 years	50 years
20	15	5.9	4.7	1.1	0.74	0.65
2.2	1.8	1.1	1.0	0.71	0.60	0.52
0.82	0.79	0.70	0.69	0.56	0.45	0.34
0.61	0.60	0.54	0.53	0.38	0.22	0.12
0.47	0.46	0.39	0.37	0.19		
0.32	0.30	0.23	0.21			

TAB 4 ● G(t) data were determined by Dynamic Mechanical-Analysis in accordance to EN ISO 6721 within the linear range of deformation. G(t) data were experimentally verified by 4-Point-Bend-Tests on laminated glass following prEN 16613 at third party labs for selected time-load combinations.

5 days	1 week	3 weeks	1 month	1 year	10 years	50 years
59	44	17	14	3.2	2.2	1.9
6.5	5.3	3.2	2.9	2.1	1.8	1.5
2.4	2.3	2.1	2.0	1.6	1.3	1.0
1.8	1.8	1.6	1.6	1.1	0.65	0.35
1.4	1.4	1.1	1.1	0.56		
0.94	0.88	0.68	0.62			

TAB 5 ● E(t) was calculated according E(t) = 2 x G(t) x (1+v) for isotropic materials with v = 0.47. The Poisson ratio v was measured in accordance to EN ISO 527 (23 °C, 30 % rel. H.).

Up to 100 % higher stiffness of Trosifol® Extra Stiff Pro vs. competitive stiff PVB

POST GLASS BREAKAGE COMPARISON TESTING VS. EXISTING PVB GRADE

TEST SETUP

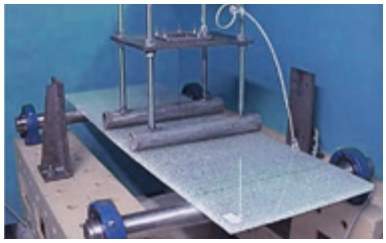
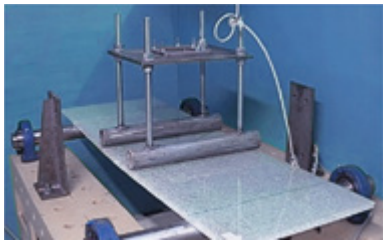
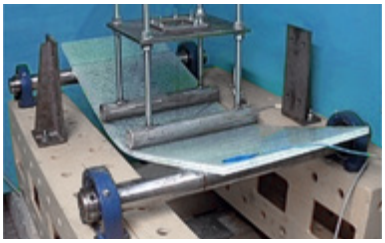
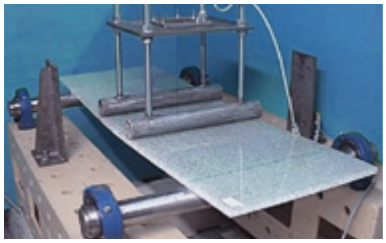
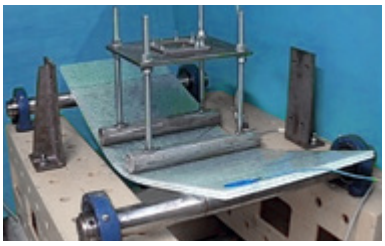
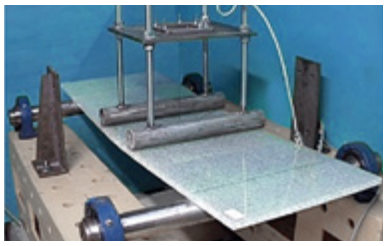
Panel Dimension (L x W):
1100 x 360 mm – both glazed elements broken

Laminate construction:
2 x 6 mm FT-Glass laminated with 1.52 mm interlayer

Test rig:
800 mm between lower panel support beams and 200 mm between upper load-support beams

Test load: 100 N

Trosifol® Extra Stiff Pro

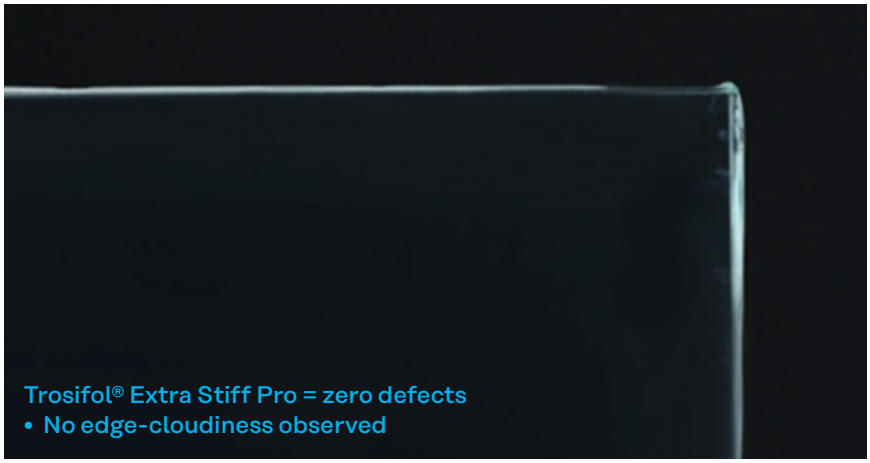
Deflection [time]	Other stiff PVB control sample	Trosifol® Extra Stiff Pro
0 seconds		
1 minute		
5 minutes		
7.5 minutes		
1.5 hours	N/A – Panel failed @ 7.5 minutes	

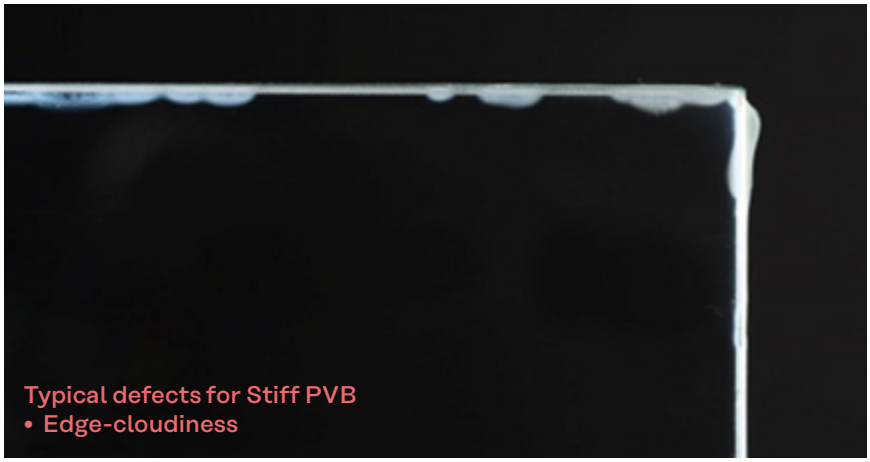
TAB 6

EDGE STABILITY COMPARISON

Laminated glass edge stability

Results after Saltwater Spray Testing 5000 h acc. ASTM B117-11





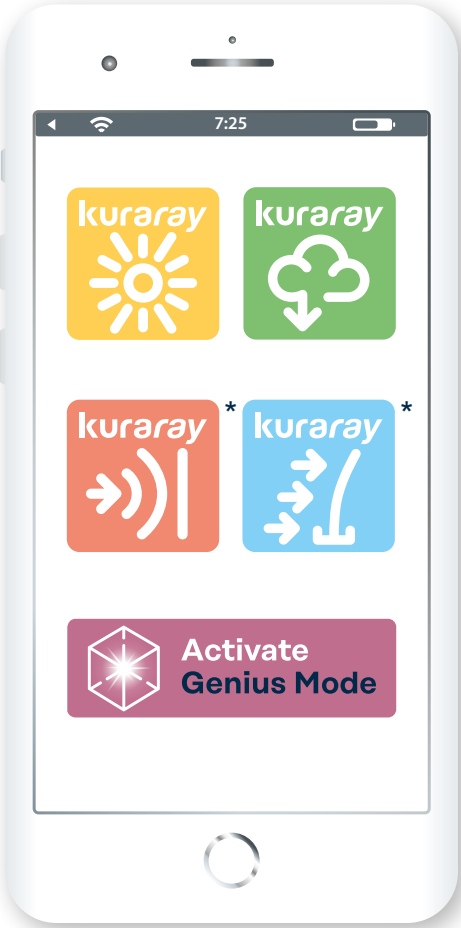
Superior edge stability with zero defects after 5000 h long term exposure

Tools & Apps

WINSLT
For calculating the light, solar and heat parameters of glazing specifically containing films from the Trosifol® & SentryGlas® product range.

SOUNDLAB AI
First global acoustic calculator based on artificial intelligence for calculating/ estimating acoustic performance of monolithic, double and triple glazed units.

GENIUS MODE
AI-powered Genius Mode optimizes glass design across Carbon Reduce AI, SoundLab AI and Strength Lab AI web apps.



* Only available as web app

CARBON REDUCE AI
Our new Carbon Reduce AI tool uses the power of artificial intelligence to help you determine the carbon footprint of glass structures such as laminated safety glass and insulating glass.

STRENGTH LAB AI
The goal of the Strength Lab AI tool is to provide designers, engineers, and architects with an efficient tool to facilitate the design and evaluation of glazing systems in terms of structural properties. This tool provides rapid analysis of virtually any glazing configuration, dimension and load case. Additionally, standard modules allow easy evaluation of results according to ASTM, EN and DIN standards.

Contact



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You can find further information on our Trosifol® and SentryGlas® products at www.trosifol.com.

Kuraray America, Inc.
Advanced Interlayer Solutions Division
3700 Bay Area Boulevard
Suite 680
Houston, TX 77058, USA
P +1 800 635 3182

Kuraray Europe GmbH
Advanced Interlayer Solutions Division
Kronenstr. 55
53840 Troisdorf
Germany
P +49 2241 2555 226

Kuraray Co., Ltd
Advanced Interlayer Solutions Division
Tokiwabashi Tower
2-6-4 Otemachi, Chiyoda-ku
Tokyo 100-0004, Japan
P +813 6701 1508

trosifol@kuraray.com

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