

English

Technical data

# Interlayers

Classification according to EN16612:2019  
and EN16613:2019 - Simplified method

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**kuraray**

**Trosifol®**

**SentryGlas®**

## European codes

# Introduction

This document provides the technical data for Trosifol® PVB and SentryGlas® ionoplast interlayers which is required in the two following European codes:

### EUROPEAN CODES

- EN 16612:2019 – Glass in building – Determination of the lateral load resistance of glass panes by calculation
- EN 16613:2019 – Glass in building – Laminated glass and laminated safety glass – Determination of interlayer mechanical properties

The technical data is provided for the following Trosifol® interlayers:

- Trosifol® Clear / Trosifol® Ultra Clear
- Trosifol® Extra Stiff
- Trosifol® Extra Stiff Pro
- Trosifol® SC Monolayer
- Trosifol® SC Multilayer
- SentryGlas®
- SentryGlas Xtra®

The data provided in the following tables allows the calculation of laminated glass stress and deformation according to the simplified method as described in Annex D of EN16612:2019

This method allows to calculate the equivalent thickness of a specific laminated glass make-up using a factor  $\omega$  which characterizes the coupling characteristics of the interlayer. This factor can vary between 0 (no coupling) and 1 (full coupling).

Since the coupling function of the interlayer is time and temperature dependent, the method also defines 12 load cases for which the  $\omega$  factors are shown in the attached tables.







• The Eiffel Tower, Paris, France

The  $\omega$  factor is derived from the Young Modulus of the interlayer. Kuraray has calculated and published the Young modulus for all its interlayers and they are available on the website in our ***Elastic Properties Data Sheet***.

The Young modulus is derived from the Shear modulus which is measured using test method EN ISO 6721. Kuraray has elected to calculate and publish the Young Relaxation Modulus  $E(t)$  since load tests on laminated glass have shown excellent correlation between calculation with that modulus and the measurements. More information can be found in the following paper: ***Determination of Interlayer Mechanical Properties for Use in Laminated Glass Design***

The simplified method also groups different interlayers in stiffness families 0,1 and 2. The tables show in which families the Trosifol® interlayers are classified.

Beside the simplified method, EN 16612:2019 also allows the use of the mechanical properties of the interlayer ( $E(t)$ ,  $G(t)$ ) of a specific interlayer in numerical simulation tools (FEA). In that case the tables with the mechanical properties of the Trosifol® interlayers on our website should be used.

Kuraray also offers a number of tools for the calculation of laminated glass properties on the website. They can be found on our website in ***the architect's and engineer's corner***.

# Young modulus E(t)

## Trosifol® Extra Stiff, Trosifol® Extra Stiff Pro, SentryGlas® and SentryGlas Xtra®

Load case according to EN16612:2019	Load duration	Max. temperature		Trosifol® Extra Stiff	Trosifol® Extra Stiff Pro	SentryGlas®	SentryGlas Xtra®
		[°C]	[°F]	E(t) [MPa]	E(t) [MPa]	E(t) [MPa]	E(t) [MPa]
Wind gust load – Mediterranean areas	3 sec	35	95	17	56	302	208
Wind gust load – other regions	3 sec	20	68	690	910	612	459
Wind Storm load – Mediterranean areas	10 min	35	95	2.3	2.6	141	65
Wind Storm load – other regions	10 min	20	68	140	350	525	340
Balustrade loads – no crowds	30 sec	30	86	29	74	349	250
Balustrade loads – crowds	5 min	30	86	5.8	12.1	243	163
Maintenance loads	30 min	40	104	1.8	1.8	34	20
Snow load – external canopies, roofs of unheated buildings	3 weeks	0	32	13	-	639	222
Snow load – roofs of heated buildings	5 days	20	68	3.1	6.5	380	87
Climatic loads – IGU summer	6 hours	40	104	1.4	1.4	17	7.8
Climatic loads – IGU winter	12 hours	20	68	7.7	41	438	148
Permanent	50 years	60	140	-	-	2.2	0.2

**TAB 1** • E(t): Young relaxation modulus

E(t) was calculated according  $E(t) = 2 \times G(t) \times (1+\nu)$  for isotropic materials with:  $\nu = 0.47$  (Trosifol® Extra Stiff, Trosifol® Extra Stiff Pro),  $\nu = 0.48$  (SentryGlas®, SentryGlas Xtra®)

The Poisson ratio  $\nu$  was measured in accordance to EN ISO 527 (23°C, 30% r. H.).

Data source: [https://www.trosifol.com/fileadmin/user\\_upload/TROSIFOL/support/downloads/technical\\_information/Elastic\\_Properties\\_Data\\_Sheet.pdf](https://www.trosifol.com/fileadmin/user_upload/TROSIFOL/support/downloads/technical_information/Elastic_Properties_Data_Sheet.pdf)

# Stiffness family and $\omega$ (omega) coupling factor

Trosifol® Extra Stiff, Trosifol® Extra Stiff Pro, SentryGlas® and SentryGlas Xtra®

Load case according to EN16612:2019	Load duration	Max. temperature		Trosifol® Extra Stiff		Trosifol® Extra Stiff Pro		SentryGlas®		SentryGlas Xtra®	
		[°C]	[°F]	$\omega$	Stiffness family	$\omega$	Stiffness family	$\omega$	Stiffness family	$\omega$	Stiffness family
Wind gust load – Mediterranean areas	3 sec	35	95	0.1	1	0.5	2	0.5	2	0.5	2
Wind gust load – other regions	3 sec	20	68	0.7	2	0.7	2	0.7	2	0.7	2
Wind Storm load – Mediterranean areas	10 min	35	95	0.1	2	0.1	2	0.1	2	0.1	2
Wind Storm load – other regions	10 min	20	68	0.5	2	0.5	2	0.5	2	0.5	2
Balustrade loads – no crowds	30 sec	30	86	0.5	2	0.5	2	0.5	2	0.5	2
Balustrade loads – crowds	5 min	30	86	0.1	1	0.3	2	0.3	2	0.3	2
Maintenance loads	30 min	40	104	0.1	2	0.1	2	0.1	2	0.1	2
Snow load – external canopies, roofs of unheated buildings	3 weeks	0	32	0.3	2	0.3	2	0.3	2	0.3	2
Snow load – roofs of heated buildings	5 days	20	68	0.1	2	0.1	2	0.1	2	0.1	2
Climatic loads – IGU summer	6 hours	40	104	0.1	2	0.1	2	0.1	2	0.1	2
Climatic loads – IGU winter	12 hours	20	68	0.1	1	0.3	2	0.3	2	0.3	2
Permanent	50 years	60	140	0	0 & 1 & 2	0	0 & 1 & 2	0	0 & 1 & 2	0	0 & 1 & 2

**TAB 2** •  $\omega$ : Omega coupling value according to table D.3 of Annex D of EN16612:2019

Stiffness family according to tables in Paragraph 7.3 of EN16613:2019

# Young modulus E(t)

## Trosifol® Clear / UltraClear, Trosifol® SC Monolayer, Trosifol® SC Multilayer

Load case according to EN16612:2019	Load duration	Max. temperature		Trosifol® Clear / UltraClear		Trosifol® SC Monolayer		Trosifol® SC Multilayer	
		[°C]	[°F]	E(t) (MPa)	Stiffness family	E(t) (MPa)	Stiffness family	E(t) (MPa)	Stiffness family
Wind gust load – Mediterranean areas	3 sec	35	95	1.5	1	1.1	1	(*)	1
Wind gust load – other regions	3 sec	20	68	20	1	2.0	0	(*)	0
Wind Storm load – Mediterranean areas	10 min	35	95	0.95	1 & 0	0.52	1 & 0	(*)	1 & 0
Wind Storm load – other regions	10 min	20	68	1.9	1	1.1	1	(*)	1
Balustrade loads – no crowds	30 sec	30	86	1.5	1	1.0	1	(*)	1
Balustrade loads – crowds	5 min	30	86	1.2	1	0.78	0	(*)	0
Maintenance loads	30 min	40	104	0.58	0 & 1	0.26	0 & 1	(*)	0 & 1
Snow load – external canopies, roofs of unheated buildings	3 weeks	0	32	4.0	1	1.2	1	(*)	1
Snow load – roofs of heated buildings	5 days	20	68	0.98	0 & 1	0.32	0 & 1	(*)	0 & 1
Climatic loads – IGU summer	6 hours	40	104	0.27	0 & 1	0.09	0 & 1	(*)	0 & 1
Climatic loads – IGU winter	12 hours	20	68	1.2	1	0.59	0	(*)	0
Permanent	50 years	60	140	-	0 & 1 & 2	-	0 & 1 & 2	(*)	0 & 1 & 2

**TAB 3** • E(t): Young relaxation modulus

E(t) was calculated according  $E(t) = 2 \times G(t) \times (1+\nu)$  for isotropic materials with:  $\nu = 0.49$  (Trosifol® Clear, Trosifol® SC Monolayer). The Poisson ratio  $\nu$  was measured in accordance to EN ISO 527 (23°C, 30% r. H.).

Data source: [https://www.trosifol.com/fileadmin/user\\_upload/TROSIFOL/support/downloads/technical\\_information/Elastic\\_Properties\\_Data\\_Sheet.pdf](https://www.trosifol.com/fileadmin/user_upload/TROSIFOL/support/downloads/technical_information/Elastic_Properties_Data_Sheet.pdf)

(\*) No E(t) data for Trosifol® SC Multilayer due to anisotropic material behavior.

# Stiffness family and $\omega$ (omega) coupling factor

## Trosifol® Clear / UltraClear, Trosifol® SC Monolayer, Trosifol® SC Multilayer

EN 16613 load case	Load duration	Max. temperature		Trosifol® Clear / UltraClear		Trosifol® SC Monolayer		Trosifol® SC Multilayer	
		[°C]	[°F]	$\omega$	Stiffness family	$\omega$	Stiffness family	$\omega$	Stiffness family
Wind gust load – Mediterranean areas	3 sec	35	95	0.1	1	0.1	1	0.1	1
Wind gust load – other regions	3 sec	20	68	0.3	1	0	0	0	0
Wind Storm load – Mediterranean areas	10 min	35	95	0	1 & 0	0	1 & 0	0	1 & 0
Wind Storm load – other regions	10 min	20	68	0.1	1	0	1	0	1
Balustrade loads – no crowds	30 sec	30	86	0.1	1	0.1	1	0.1	1
Balustrade loads – crowds	5 min	30	86	0.1	1	0	0	0	0
Maintenance loads	30 min	40	104	0	0 & 1	0	0 & 1	0	0 & 1
Snow load – external canopies, roofs of unheated buildings	3 weeks	0	32	0	1	0.1	1	0.1	1
Snow load – roofs of heated buildings	5 days	20	68	0	0 & 1	0	0 & 1	0	0 & 1
Climatic loads – IGU summer	6 hours	40	104	0	0 & 1	0	0 & 1	0	0 & 1
Climatic loads – IGU winter	12 hours	20	68	0.1	1	0	0	0	0
Permanent	50 years	60	140	0	0 & 1 & 2	0	0 & 1 & 2	0	0 & 1 & 2

**TAB 4 •**  $\omega$ : Omega coupling value according to table D.3 of Annex D of EN16612:2019

Stiffness family according to tables Paragraph 7.3 of EN16613:2019

Stiffness family for Trosifol® SC Multilayers has been determined through the following steps:

1. Converting the boundary Young modulus values (EL) as specified in the tables of paragraph 7.3 of EN 16613:2019, to G boundary values using the formula  $E=3G$ .
2. Comparing the published G(t) values of the Trosifol® SC Multilayer to the G boundary values for each stiffness family.

# Contact



## FOR FURTHER INFORMATION

on products from Kuraray, please visit [www.kuraray.com](http://www.kuraray.com).

You can find further information on our Trosifol® and SentryGlas® products at [www.trosifol.com](http://www.trosifol.com).

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