Laminated Glass and Unsupported Glass Pane Creep

Laminated glass panels installed in structurally glazed applications may not always have the full laminate glass thickness supported along its bottom edge. In the case of a fully unsupported outer glass, with the outer glass panel supported by the interlayer only, this can result is a displacement of the outer glass panel compared to its original position. This phenomenon is referred to as “creep”. In order to avoid issues as a result of creep, it is recommended that the outer glass panel is at least partially supported. To be able to assess potential effects, a laboratory scale test method to assess creep performance in laminates has been developed since in-situ data is difficult to obtain.

A short summary of the interlayer creep test method, and results of subsequent testing of various laminated architectural glass products are presented in this document. Laminates were subjected to high temperatures over an extended period of time using a test method which allows the front glass to remain supported only by the polymer interlayer while the back glass is fully edge supported. The resulting change in glass alignment is reported, thus providing a measure of creep which has occurred under the described test conditions.

Laminates were heated in an oven at 100°C for 1000 hours to determine the amount of creep with measurements taken at 24, 100, 250, 500 and 1000 hours heating time. The temperature for this study was specifically chosen for multiple reasons: (a) it is at a temperature at which hydrogen bonding weakens due to molecular vibrations, (b) it is sufficiently above the temperature expected for highly absorbant spandrel or dark glass (~2% Visbile light transmittance) in extreme climates (55°C day, no wind, glass surface temperature of 75°C) and (c) it is the standarized test temperature established by all safety glazing standards for laminated glass (bake or boil tests) deemed to demonstrate proper lamination and durability.

No visible defects, such as bubbles or delaminations, were seen in any of the laminates tested. Edge discoloration was inconsistently noted in some samples at 1000 hours when exposed at 100ºC.

According to ASTM International C 1172[5], *Standard Specification for Laminated Architectural Flat Glass* and *ISO 12543[6], Glass in building -- Laminated glass and laminated safety glass -- Part 5*: *Dimensions and edge finishing*, the maximum allowable displacement whether due to out of square dimensioning or layer shift of glass during manufacturing is between 4 and 8 mm. Using that information as the pass/fail criteria for creep, allowance was set at 6 mm. For this test method, the assessment of creep greater than 6 mm occurring at any time during the testing, be it consistent across the laminate or sloped across the edge, is deemed as an interlayer that requires full edge support during installation and is designated as: “Full Support Required”. All other laminates exhibiting less than 6 mm creep from origin are designated: “Creep resistant”.

The following table indicates the laminate configurations tested, final creep distance at 1000 hours of exposure (unless indicated otherwise) and Creep Resistance Rating (CRR).

Case Number	Interlayer	Thickness	Creep Distance			Rating
			Unsupported Glass Thickness			CRR
			3 mm	6 mm	10 mm	
1	Saflex Clear Conventional R-series	0.76 mm	1	2	3	**Creep Resistant** (for all glass thicknesses tested)
2	Saflex DM	1.27 mm	0.5	0.5	0.5	**Creep Resistant** (for all glass thicknesses tested)
3	Saflex Structural (DG)	0.76 mm	0.0	0.0	0.0	**Creep Resistant** (for all glass thicknesses tested)
4	Saflex Storm (VS)	1.95 mm	0.5	0.5	0.5	**Creep Resistant** (for all glass thicknesses tested)
5	Saflex Acoustic (QS)	0.76 mm	---	7.0	---	**Full Support Required** (borderline – check with manufacturer)
6	Ionomer*	0.89 mm	29	---	---	**Full Support Required**
7	Ionomer*	1.52 mm	---	100+[1]	---	**Full Support Required**

1 Maximum creep allowed by frame geometry occured at 24 hours, test of this sample was terminated.

*Commercially available ionomer sample

Saflex Clear, conventional formulation PVB, Saflex DM, semi-rigid, Saflex Storm, composite interlayer, and Saflex Structural PVB all perform well. Acoustic PVB interlayers exhibits creep as does ionomer interlayer and both should be fully supported in use.

References

1. ASTM C 1172, *Standard Specification for Laminated Architectural Flat Glass*, ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA USA. www.astm.org
2. *ISO 12543, Glass in building -- Laminated glass and laminated safety glass -- Part 5*: *Dimensions and edge finishing*, International Organization on Standardization ISO Central Secretariat Ch. de Blandonnet 8 Case Postale 401 CH – 1214 Vernier, Geneva Switzerland. www.iso.org

Further reading

Structural Glazing – Creep Deformation of PVB in Architectural Applications, Dr. Pol D'Haene, Solutia Europe SA/NV Glass Processing Days, 18–21 June 2001 www.glassfiles.com

Adhesion, creep and relaxation properties of PVB in laminated safety glass, Prof. Ing. Maurizio Froli, Dr. Ing. Leonardo Lani, Department of Civil Engineering, Structural Division, University of Pisa, Via Diotisalvi 2, Pisa -Italy

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Keywords: architectural glass, creep, slippage, durability, glass interlayers, laminated glass