



Standard Test Method for Non-Destructive Photoelastic Measurement of Edge and Surface Stresses in Annealed, Heat-Strengthened, and Fully Tempered Flat Glass¹

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^{€1} NOTE—Equation 11 was editorially revised in October 2001.

1. Scope

1.1 This test method covers the determination of edge stresses and surface stresses in annealed, heat-strengthened, and fully tempered flat glass products.

1.2 This test method is non-destructive.

1.3 This test method uses transmitted light and is, therefore, applicable to light-transmitting glasses.

1.4 The test method is not applicable to chemically-tempered glass.

1.5 Using the procedure described, surface stresses can be measured only on the “tin” side of float glass.

1.6 Surface-stress measuring instruments are designed for a specific range of surface index of refraction.

1.7 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*

C 162 Terminology of Glass and Glass Products²

C 770 Test Method for Measurements of Glass Stress-Optical Coefficient²

C 1048 Specification for Heat-Treated Glass: Kind HS, Kind FT Coated and Uncoated Glass²

F 218 Test Method for Analyzing Stress in Glass

2.2 *Other Documents:*

*Engineering Standards Manual*³

“Surface and Edge Stress in Tempered Glass”⁴

3. Terminology

3.1 *Definitions:*

3.1.1 *analyzer*—a polarizing element, typically positioned between the specimen being evaluated and the viewer.

3.1.2 *polarizer*—an optical assembly that transmits light vibrating in a single planar direction, typically positioned between a light source and the specimen being evaluated.

3.1.3 *retardation compensator*—an optical device, variants of which are used to quantify the optical retardation produced in transparent birefringent materials: typically positioned between the specimen being evaluated and the analyzer.

3.2 For definition of terms used in this test method, refer to Terminology C 162.

4. Summary of Test Methods

4.1 Two test methods are described in this standard:

4.1.1 *Procedure A* describes a test method for measuring surface stress using light propagating nearly parallel to the surface.

4.1.2 *Procedure B* describes a test method for measuring edge-stress using light propagating in the direction perpendicular to the surface.

4.2 In both methods, the fundamental photoelastic concept is used. As a result of stresses, the material becomes optically anisotropic or birefringent. When polarized light propagates through such anisotropic materials, the differences in the speed of light rays vibrating along the maximum and minimum principal stress introduce a relative retardation between these rays. This relative retardation is proportional to the measured stresses, and can be accurately determined using compensators. For additional background see “Surface and Edge Stress in Tempered Glass”⁴.

5. Significance and Use

5.1 The strength and performance of heat-strengthened and fully-tempered glass is greatly affected by the surface and edge stress induced during the heat-treating process.

¹ This test method is under the jurisdiction of ASTM Committee C14 on Glass and Glass Products and is the direct responsibility of Subcommittee C14.08 on Flat Glass.

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² *Annual Book of ASTM Standards*, Vol 15.02.

³ Available from GANA, 3310 Harrison, Topeka, Kansas.

⁴ Redner, A. S. and Voloshin, A. S., *Proceedings of the Ninth International Conference on Experimental Mechanics*, Denmark, 1990.