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NGA GLASS CONFERENCE™
CHICAGO — JULY 18-20, 2022

FABRICATING: TEMPERING

Rick Wright
Oldcastle
BuildingEnvelope

ASTM C14 UPDATE

- ASTM C1048 Update

- 2021 New ASTM Standards
  - C1908-21 Standard Test Method for Pummel Adhesion Testing of Two-ply Laminated Architectural Glass.
  - C1914-21 Standard Test Method for Bake and Boil Testing of Laminated Glass

- 2021 Revisions to Existing ASTM Standards
  - C1464-21 Standard Specification for Bent Glass
  - C1376-21a Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass

ASTM C14 UPDATE

ASTM Standard Requiring Review for Ballot

- C1349-2017 Standard Specification for Architectural Flat Glass Clad Polycarbonate
  - Urmilla Sowell, NGA, Chair of review task group

ASTM Active Work Items

- New Test Method for Center-Punch Fragmentation of Fully Tempered Glass
  - Urmilla Sowell, NGA, Task Group Chair; resolve ballot negatives/comments

- New Test Method for Tunnel Testing of Transparent Glazing Materials Using a Binomial Choice Protocol for Perpendicular Specimen Configuration (New Title)
  - Kevin Ramus, KR Glass Consulting, and Stefan Knust, ENNEAD ARCHITECTS LLP, Co-Chairs of task group
  - Document went to concurrent sub/main ballot July 2022

GLASS TECHNICAL PAPER (GTP) METHODS FOR MEASURING DISTORTION

Task Group Chair: Chuck Wencl, Viracon

Ballot Comments:

- Disapprove: add visible example for roller wave or milli-diopters
- Approve: there are terms used in the Digital Photography Methods / 2nd paragraph that I've not heard of before, but which are not in the Definitions section, such as "edge kink," "bi-stability," "hammer or pocket distortion

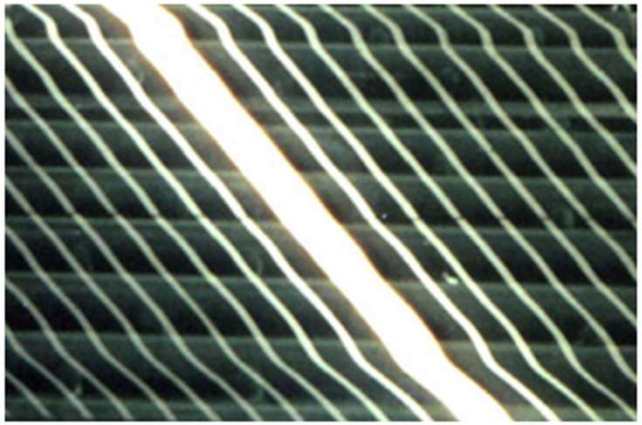

Figure 2: Roll wave in glass viewed in reflection

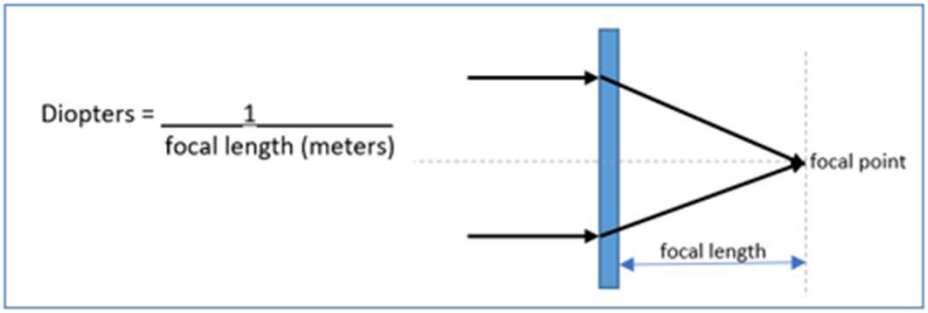

Figure 3: The reciprocal of the focal length is the diopter.

BEST PRACTICES FOR HEAT SOAK

Off-Line Process

Step 1: Tempering Process

Step 2: Off-Line Heat Soak Process

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Glass Technical Paper **FB56-18**

Heat Soaking Testing of Tempered Glass for Architectural Glass Applications

Introduction

Fully tempered (FT) glass used in architectural applications may break spontaneously for a variety of reasons, including, but not limited to, unperceivable imperfections or inclusions in the glass substrate. Most inclusions are stable, but some inclusions, most notably nickel sulfide, may cause a spontaneous break if it is located in the tension region. The purpose of a heat soak test is to reduce the risk of a spontaneous break by influencing the inclusion to break the glass during the test. It is important to remember a heat soak test may reduce the risk, but will not eliminate the potential of a spontaneous break due to an inclusion.

Glass Type

Heat soak testing may be done on any fully tempered architectural glass including, but not limited to, clear, tinted, low-iron, patterned and low-E coated glass. Reference ASTM C1036 and C1376 for more information on glass types and properties.

The Effect of Heat Soak Testing on the Temper of Glass

There is currently no North American standard for heat soak testing. Some companies in North America perform heat soak testing in accordance with EN 14179-1 Heat soaked thermally toughened soda lime silicate safety glass. This standard has specific instructions for the heat soak testing. When the heat soak test is performed as specified, there should be very little to no effect on the surface compression of the tempered glass.

Statistical Heat Soak vs. 100% Heat Soak

There have been two basic approaches taken with the heat soak testing. The first is to heat soak each lite required for the project. A second approach is a statistical approach. Statistical heat soak testing involves the selection of a statistically significant number of glass panels to be tested, as opposed to 100% of the glass. It is important to recognize that there is no consensus on the statistical procedures used with this approach. EN 14179-1 requires all lites to be heat soaked.

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CENTER PUNCH TEST METHOD

- Is there an alternate to Center Punch test method?
- Could glass stress measurement be an alternate?

ASTM E1300 CERAMIC ENAMEL UPDATE

TIM MCGEE, GCC

The ceramic frit related revision work continues under work item ASTM WK65259

- Ceramic frits on monolithic glass and lites as part of an IGU.
- Data collected by breaking fritted and heat-strengthened glass panels
- Ballot proposal to add a note to the Scope of E1300: “Ceramic enamel is known to affect glass load resistance. Consult the manufacturer for guidance.”
- This statement was added to partly address the use of ceramic enamels while working group 65259 of Task group 06.52.10 continues development of a “simple” method to determine load factors when ceramic enamels are used

GLASS TECHNICAL PAPERS- UPDATED

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Glass Technical Paper **FB20-08 (2022)**

Iridescence in Heat-Treated Architectural Glass

Glass used in architecture today commonly includes clear and tinted glass substrates, low-emissivity and solar-control coatings, decorative ceramic-frit patterns and safety glazing considerations that require glass to be heat-treated. Heat-strengthened and fully tempered glass is designed to meet increased thermal and mechanical stresses, or other specified physical criteria. Tempered glass is also used to meet safety glazing code requirements. As a result of the heat-treating process, iridescence, or what is often referred to as a quench pattern/mark, strain pattern or anisotropy, may be visible in heat-strengthened and fully tempered glass under certain polarized lighting conditions.

The accepted industry consensus standard for heat-treated glass, ASTM International C1048 – *Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass*, addresses this optical phenomenon as follows:

7.2 *Strain Pattern* — a strain pattern, also known as iridescence, is inherent in all heat-strengthened and fully tempered glass. This strain pattern may become visible under certain polarized lighting conditions. It is a characteristic of heat-treated glass and should not be mistaken as discoloration, non-uniform tint or color, or a defect in the glass. The strain pattern does not affect any physical properties or performance values of the glass.

The intensity of the strain pattern may vary from lite to lite, and/or within a given lite. The presence of a strain pattern or the perceivable differences in the strain pattern is not a glass defect or blemish and is not a cause for rejection.

Commercial anisotropy scanners are available from several equipment suppliers to measure iridescence in glass in the manufacturing or fabrication facility. ASTM C1901 *Standard Test Method for Measuring Optical Retardation in Flat Architectural Glass* provides a method to quantify (in nanometers) the amount of iridescence that may be visible under certain polarized lighting conditions in heat treated flat monolithic glass. Note that this ASTM standard does not define an acceptable/unacceptable amount of iridescence; only the method to measure it.

The Heat-Treating Process

In order to provide the required resistance to thermal and mechanical stresses, and to achieve specific break patterns for safety glazing applications, annealed float glass is strengthened through a thermal process known as heat-treating. Heat-treating includes both heat-strengthened and fully tempered glass. The most commonly used process for heat-treating architectural glass requires the glass to be cut to the desired size and shape. The edges are seamed, ground or polished as specified, then the glass is washed, and transported into a furnace.

See Figure 1 for an outline of the heat-treating process.

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Glass Technical Paper **FB52-17 (2022)**

Guidelines for the Production of Heat-Treated Architectural Flat Glass

Since the 1930s, the glass industry has been producing heat-treated architectural glass. The process of heat-treating glass involves uniformly heating glass close to its softening temperature and then rapidly, and uniformly, cooling it. Heat-treated glass is used in many of today's architectural glazing applications where increased strength to resist glass breakage is desired. This Paper gives guidelines for producing heat-treated glass. Guidelines should be regarded as a general starting point, but for more detail consult your vendors and equipment manufacturers.

Personal Protection Equipment (PPE)

Do:

- Stress to employees each day the importance of the proper use of safety equipment at every stage of the glass fabrication process
- Have available and wear such personal protection equipment, including:
  - Hardhat
  - Safety glasses
  - Cut-resistant clothing material such as shirt/jacket and chaps
  - Steel-toe boots with metatarsal guards
  - Minimum Level 4 cut-resistant gloves and glove liners (when handling raw edges)
  - Ear plugs
  - Face shield
- Reference ASTM E2875 Standard Guide for Personal Protective Equipment for the Handling of Flat Glass
- Report any problems performing routine tasks as a result of the PPE
- Always check those working in your area to ensure they are wearing the proper PPE
- Always check your PPE to ensure it is in good condition, no holes, tears or missing components

Don't:

- Don't assume others are wearing the proper PPE for your work area
- Don't take short cuts when it comes to PPE – ensure it's always worn and in good working condition
- Don't modify PPE from its original design

General Glass Processing

Do:

- Always wear proper PPE: see previous section