NATIONAL GLASS ASSOCIATION with GANA

Glass Technical Paper **FB56-18 (2024)**

Heat Soak Testing of Tempered Glass for Architectural Glass Applications

Introduction

Fully tempered glass used in architectural applications may spontaneously break infrequently for a variety of reasons, including, but not limited to, unperceivable imperfections or inclusions in the glass substrate. During the tempering process, the glass is heated and rapidly cooled. Most inclusions are stable, however during the rapid quenching process of fully tempered glass, some unstable inclusions can be trapped in the tension region. These unstable inclusions, most notably nickel sulfide (NiS), can cause spontaneous breakage if their physical form changes due to heating and cooling once installed. This document refers to breakage due to NiS inclusions.

The purpose of a heat soak test is to reduce the risk of a spontaneous breakage in the field by influencing the NiS inclusion to break the glass during the test. It is important to remember a heat soak test will reduce the risk, but will not completely eliminate the potential of a spontaneous break due to a NiS inclusion. There are a multitude of variables that could affect if a NiS inclusion will be present in the glass during the manufacturing process, and if a NiS inclusion will cause the glass to spontaneously break. Consult with the fabricator for heat soaking benefits for your specific project.

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. It does not impact visual or performance characteristics of the glass passing the test. Reference ASTM C1036 *Standard Specification for Flat Glass* and C1376 *Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass* for more information on glass types and properties. Heat soak testing is only applicable to fully tempered glass; not to heat strengthened or annealed glass.

Laminated glass may be comprised of glass layers which are fully tempered. Interlayers have the ability to contain the broken glass pieces should a spontaneous breakage to one or more of the glass layers occur. The heat soak testing of glass layers which are to be used in the construction of laminated glass units is typically not necessary.

The Effect of Heat Soak Testing on Surface Compression 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 14179-1:2016 *Glass in building - heat soaked thermally toughened soda lime silicate safety glass* or ISO 20657 *Glass in building — Heat soaked tempered soda lime silicate safety glass*. These standards are equivalent and have specific instructions for the heat soak testing. When the heat soak test is performed as specified, there is typically no effect on the surface compression of the tempered glass.

Statistical Heat Soak vs. 100% Heat Soak

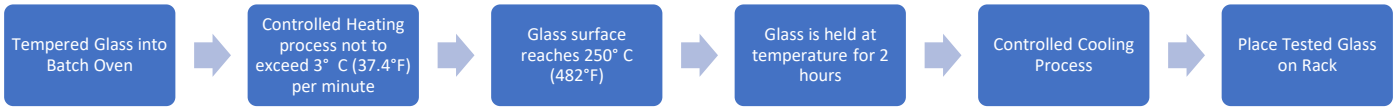
There is no consensus on using a statistical sampling approach (not all lites tested); EN 14179-1:2016/ISO 20657 requires all lites to be heat soaked.

Heat Soak Testing Process

The process of heat soak testing tempered glass is defined in EN14179-1:2016 and ISO 20657. Heat soak testing subjects the fully tempered glass to specific temperatures for a fixed amount of time through an additional heating step to accelerate glass breakage caused by potentially harmful NiS inclusions in the glass. Any breakage that occurs during the heat soak test will reduce spontaneous glass breakage in the field due to NiS inclusions. The off-line process is a batch process in which fully tempered glass is heat soak tested in an oven at some time after the tempering process.

Step 1: Tempering Process

Step 2: Off-Line Heat Soak Process, according to EN14179-1:2016 and ISO 20657:



According to EN14179-1:2016 and ISO 20657, the oven must be heated so that the glass temperature itself reaches 260° C (500°F) +/- 10° and is maintained through the soak phase.

Effect on Post-Temperable Low-E Coatings

The temperatures that the glass is subjected to during heat soak testing are low compared to the temperatures used for heat-treating. However, the coated glass supplier should be contacted for specific guidance when coated product is being heat soak tested.

Effect on Iridescence

When the EN14179-1:2016/ISO 20657 heat soak procedure is followed, the glass is allowed to cool to ambient conditions without the assistance of fans or blowers. There should be no effect on iridescence. Reference EN14179-1:2016 and ISO 20657 for more information.

Cost Implications

To evaluate the cost-benefit of heat-soak testing, the project design professional should consider all factors in the analysis including, but not limited to, the volume of tempered glass, the glass construction, the consequences of glass breakage within the glazing system, etc. To reduce the possibility of spontaneous breakage due to NiS inclusions

and preclude the need for heat soak testing, heat-strengthened glass may be utilized where heat treated glass is being considered, however tempered glass must be selected when necessary to comply with building codes, meet design loads, and minimize thermal stress breakage.

Best Practices for Heat Soak Testing

- Follow methods prescribed in BS EN 14179-1:2016 or ISO 20657 when performing heat soak testing on fully tempered glass.
- Expect heat soak testing to nearly, but not completely, eliminate the risk of spontaneous breakage from NiS inclusion. Consider specifying heat-strengthened glass rather than fully tempered glass (unless fully tempered glass is required to comply with building codes, meet design loads, and minimize thermal stress breakage).
- Realize the heat soak process is a batch process with limited capacity that takes several hours to complete and exposes fully tempered glass to an additional heating operation and additional handling.
- The heat soak process is intended to induce breakage at the fabrication facility to reduce field breakage
- Specifying heat-soaked tempered glass requires additional processing time for the fabricator since it involves an additional process step.
    - Ensure that there is ample time built into the overall production schedule to accommodate the required processing time; this may also impact the project construction schedule.

References

- BS EN 14179-1:2016 Glass in Building - heat soaked thermally toughened soda lime silicate safety glass
- ISO 20657 Glass in building — Heat soaked tempered soda lime silicate safety glass