NSG GROUP

Technical Bulletin

ATS-186
2013-01-16

INSTALLATION OF HEAT TREATED PILKINGTON CLEAR AND TINTED (NON-COATED) FLAT GLASS

Summary

Tempered (FT) (or 'Toughened') glass is about 4 times stronger than plain annealed glass. It is used where building codes specify a 'safe' product i.e. one that either does not break under normal loads, or if it does, it breaks in a 'safe' manner with minimal risk of significant human injury.

Heat Strengthened (HS) glass is about twice as strong as plain annealed glass but does not break in a 'safe' manner. It is used for extra resistance to wind loads or thermal stress, or to possibly reduce, but not eliminate, the distortions of fully tempered glass. HS glass generally has a lesser risk of spontaneous breakage from inclusions than FT glass.

Tempering does not change the hardness of glass.

Tempering does not change the stiffness (Young's Modulus) of glass: relatively large sheets of thin tempered glass can take on roller wave or overall bow or dish shape which can effectively stiffen the plate. This is sometimes seen in IG units when efforts to add or remove air from the sealed air space to make the glass flat are unsuccessful.

Optical distortions, particularly in reflection, will always be seen to some degree in heat treated glass. During the process the thickness of the glass remains constant and so the two surfaces remain parallel to each other, but the glass does lose some of its flatness. Thus, transmission distortion is only seen at high incidence angles (grazing angles).

Different types of quench nozzle design can create different "quench patterns" in the finished product. Depending on the tempering equipment design, they can appear as small circles or

straight lines that appear as shadows or dark spots in the glass. This is easily seen with polarized lens sun glasses, and is not a defect in the product. See ATS Bulletin #157 for more details.

Heat treatment can cause a very slight increase to the visible reflection of the tin side of tinted float glass. This can occasionally be discerned when two tinted, heat treated lights, with one reversed (tin side facing in or out), are glazed side by side.

On rare occasions, heat-treated (tempered and sometimes even heat-strengthened) glass can break spontaneously, without any applied load, due to small inclusions that may be present in all float glasses.

Cleaning tempered glass with razor blades can create fine scratches because fine dirt particles can be fused to the smooth surface of glass during the tempering process. Such particles can be the source of scratches if razor blades are inadvertently used to clean the glass.

FABRICATION

Surface identification

Case and Stoce tags identify the 'Tin Side', or bottom surface, of float glass when it arrives from the glass manufacturer. An additional check can be made by looking at the cut edges where the float plant top surface score mark will be visible. (This i.d. method may not be reliable if off-line cutting has been used). Finally, the faint fluorescence from a 254 nm wavelength UV lamp can be used to confirm the tin side. A true reflection of the UV light bulb, with no fluorescence, can be noted on the atmosphere side of the glass.

Cutting

To help ensure consistent heat treated glass orientation in the final installation, all the glass processing, including cutting, should be done with a consistent orientation e.g. tin side down. Note: Shaped glass may include patterns which are not reversible so cutting layouts should not flip or reverse any shapes.

Edging

Glass for heat treatment typically is seamed, arrised, edge ground, or polished for ease of handling and to minimize breakage in the tempering operation. These processes create fine glass particles which must be completely washed off the glass before heat treatment.

Cleaning

Glass must be visibly clean before heat treatment to avoid burning in dirt, or fusing edge grinding fines and dust to the glass surface. Even wax crayon marks might appear to be burned off during heat treating, but when the glass is "fogged" or steamed the marks may be visible due to differential condensation of the water vapor.

Heating

Cycle time and temperature furnace settings depend on the glass thickness and the absorption characteristics of the glass and will vary with different furnaces; even when of the same style and design from the same manufacturer. For a given thickness, Pilkington **Optiwhite**™ Low-Iron Float Glass will require the longest heating time, while Pilkington **SuperGrey**™ will require the shortest heating time.

Quenching

The quench process should remove heat at an equal rate from the top and bottom surfaces to ensure a relatively flat product. The presence of, and contact with, relatively cool rollers under the bottom surface of the glass adds to the difficulty of creating equal air flows.

Thinner glass requires greater quench flows to establish and maintain the needed temperature gradient in the glass.

The quench flow rate should be independent of the glass tint as the heat treatment flow is primarily by forced convection.

Examination

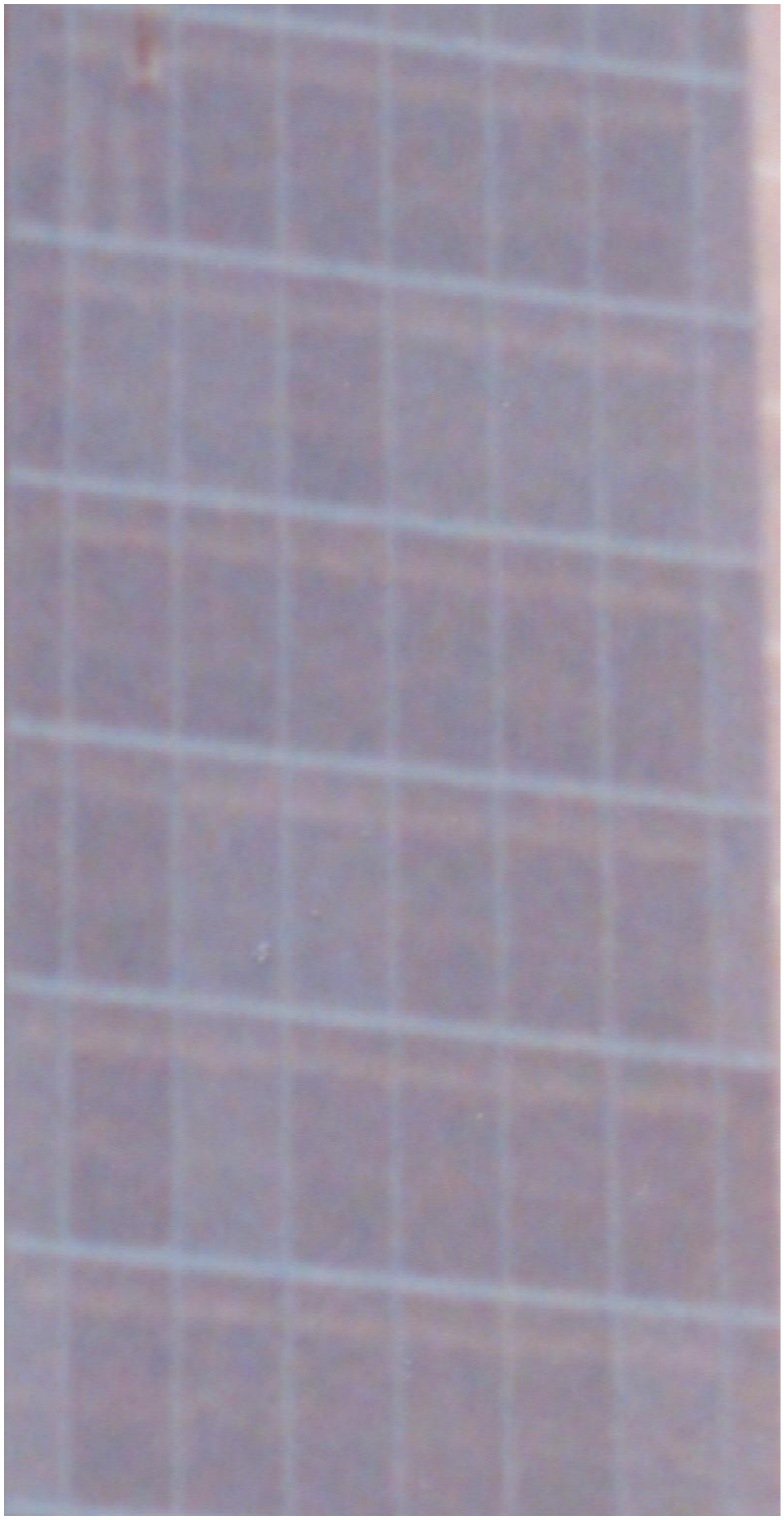
Heat treated glass should be examined to the standards specified, and for the use intended.

INSTALLATION

Float glass picks up a miniscule amount of tin from the float bath. Typically this can be detected by a faint milky tint, on the tin side only, when illuminated by a 254 nm wavelength UV lamp. A faint lightness on the tin side can sometimes be seen under certain natural lighting conditions, such as with a uniform grey sky, with thick (6 mm or greater), dark tinted, heat treated glass. Thicker glass resides a longer time in the float bath and hence has a greater opportunity to adsorb more tin. Installing a heat treated light with the tin side out immediately beside a light with the tin side in may create a barely perceptible visible difference. The obvious remedy for such differences is to control the orientation of the glass throughout fabrication and installation, and consistently place the tempered glass identifying logo on one agreed surface (top side, or tin side) so that it can be readily identified. The glass can then be installed with a consistent orientation for a non-varying appearance.

Ideally, to achieve the maximum possible exterior reflected uniformity, heat treated float glass should be installed with the tin side facing inwards.

This constant installed orientation is particularly important in structural silicone glazing, or in horizontal strip windows, where the minimal gap between adjacent lights allows the eye to readily pick up very small differences in appearance.



Example of 10 mm (3/8") thick, single glazed tempered glass, with irregular orientation. About 20 lights are perceptibly darker. This condition created a customer complaint. (The un-enhanced photograph of an eastern elevation, was taken in grey sky conditions near dawn)

DISTORTION

Heating flat glass until it is soft, for tempering or heat strengthening, will invariably create some visible distortions in the finished product:

1. The bottom surface can pick up some texture "orange peel" from the roller surface.

2. Eccentric rollers can induce "roller wave".

3. Change in roller height, or roller eccentricity, particularly in the transition from the furnace to the quench zones, can induce leading or trailing edge lift in the glass.

4. Hotter edges from the increased exposure of the glass perimeter to the heating elements can create a 'picture frame' distortion of 1" (25 mm) to 2" (50 mm) around the glass. This can be corrected by adjusting the furnace heating elements.

5. A temperature difference through the thickness of the glass, or imbalance between the top and bottom quench air supply can cause overall bowing or dishing. Broad limits for roller wave and bow or dish are published in standard ASTM C 1048.

Distortion is easily seen when both the viewer and the viewed object are at relatively large distances from the glass, especially if the viewing angle of incidence is great (grazing angles). It is very difficult to perceive distortion when standing close to glass and looking at reflected images of distant objects (the horizon), or conversely, standing far away and looking, perhaps with binoculars, at the reflection of objects close to the glass, say building columns adjacent to the glass.
