NSG GROUP

Technical Bulletin

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Handling, Inspecting, Fabricating & Glazing
Pilkington **Solar-E™** on Tinted Glass

Summary

The Pilkington **Solar-E™** low emissivity pyrolytic coating on tinted glass improves thermal insulation (low U-Factor) by the low-e property, and reduces solar heat gain (SHGC) by inhibiting the inward transmission of the solar energy absorbed in the tinted glass. The coating itself also absorbs and blocks solar infra red energy, making these products the highest performing of the Pilkington NA line.

The hard coating of Pilkington **Solar-E™** glass can be glazed monolithically, or incorporated into an insulating glass (IG) unit, with the coating on the #2 surface (room side of the outside light). It is not intended for use on the #1 surface of single glazing or IG, and it is not intended for use on the #3 surface of IG. When laminated the coating should not be in contact with the pvb interlayer. The coating needs to face air (or gas in an IG unit) in order to preserve the improved thermal performance value of the low emissivity property.

Pilkington **Solar-E™** glass can be heat treated: Heat Strengthened, Tempered, or Bent. It cannot be chemically strengthened because the coating blocks the chemical action on that one surface.

Pilkington **Solar-E™** glass can be opacified for use in spandrel panels with typical ceramic frits or water based Silicone opacifiers applied to either the glass or the coated surface. Note: applying opacifiers to the coated surface will change the appearance by reducing its reflectivity, and will mask the Low-E property, thus changing the solar and thermal performance.

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GLASS HANDLING

Care should be taken to avoid excessive contact with the coated surface of Pilkington **Solar-E**™ glass. Pilkington **Solar-E**™ glass should be cut, washed, and generally processed with the coated surface facing up. Note: heat treatment (see below) can be with the coating down against clean rollers.

INSPECTION

It is the responsibility of the fabricator to carefully inspect Pilkington **Solar-E**™ glass, both before and after washing, as well as before any further fabrication. Glass not rejected by the fabricator during inspection prior to fabrication will be considered acceptable by Pilkington.

Pilkington **Solar-E**™ glass should be inspected in ***transmitted*** and ***reflected*** light, both from the coated side, and the glass side of the light.

When inspected in ***transmitted*** light, there should be a bright, uniform, diffuse light source (similar to an overcast daytime sky) behind the glass. The objects which are seen in reflection (walls, ceilings, etc.) on the viewing side of the coated glass should be dark color or matt black and should have low level illumination on them to minimize masking reflections.

When inspected in ***reflected*** light the glass should be placed in front of a uniform, dark background to minimize transmitted images. The reflected image of a uniform diffuse light source or uniformly illuminated white wall or screen (similar to an overcast sky) should be visible to the inspector.

UNPACKING

Pilkington **Solar-E**™ glass is shipped in either standard cases or stoce. Like other Pilkington glass products, the glass surfaces are protected with a powdered interleaving material between the individual lights to inhibit moisture staining and abrasions.

Pilkington **Solar-E**™ glass should never be removed from cases by "end opening" the case since sliding glass surfaces past each other may damage the coating or the glass surface.

Pilkington **Solar-E**™ glass can be handled with suction cups. The cups must be clean and dry to prevent damage to, or marking of, the coated surface. The cups should not be slid across the coated surface.

CUTTING

Stock Sheets

The fabricator is responsible for cutting stock sheets to eliminate imperfections from the finished cut piece.

Standard procedures used in cutting ¼" (6 mm) float glass should be practiced. All stock sheet edges must be trimmed a minimum of 1" (25 mm) to obtain a clean-cut edge. Special care should be exercised in cutting to avoid sliding tools over the coated surface.

Pilkington **Solar-E™** glass should be cut with the coated side up to eliminate coating damage that could result from glass particles on the cutting table.

Cutting oils should be light, evaporating lubricants such as "Low Odor Base Solvent" No. 529-66 available from Ashland Chemical, Charlotte, NC, phone: 800 522 1409. Keep the quantity of cutting oil to a minimum to reduce contamination of gloves and to allow easier washing the coated surface.

WASHING

Pilkington **Solar-E™** glass has a pyrolytic low emissivity coating with a solar IR absorbing layer. As with any coated product, care should be taken while washing the glass to prevent damage to the coating.

Mechanical Washing

Pilkington **Solar-E™** glass should be washed, with the coating side up, in a rotating cylindrical brush, flat glass washing and drying machine. Pilkington recommends using a detergent solution of hot 50-60°C (120-140°F) clean water and a commercial detergent designed for glass washing. The final rinsing should be with clean deionized water heated to at least 43°C (110°F). As with all washing machines, either the water should be changed on a routine basis or a continuous overflow system should be used. Drying air should be filtered and controlled in such a manner so as not to leave water droplets on the glass surfaces.

Polypropylene brush rolls are recommended for glass washing machines. Nylon brushes must be properly adjusted to avoid the possibility of coated surface damage. When selecting the proper brush for washing Pilkington **Solar-E™** glass, consider that polypropylene brushes usually have a lower coefficient of friction, and are softer, and more flexible than nylon. Note: the hardness of the pyrolytic Pilkington **Solar-E™** coating means that standard glass washing machine brushes can be used without need for the special soft material brushes typically used with the softer sputtered low-e coatings. Brush height settings should be such that only the

bristle tips, rather than the sides of the bristles, sweep the glass surface uniformly across the glass width.

Do not allow the glass to remain stationary under rotating brushes.

It is recommended that a test light be run through the washer before starting production. The glass should be inspected, in transmission and in reflection, and then with a bright spotlight close to the coated surface to determine if brush and/or air drying adjustments are needed. If abrasive materials are trapped in any washing equipment, abrasion damage to the glass and coating can occur.

Hand Washing

Pilkington **Solar-E**™ glass can be cleaned and maintained by hand washing with non-abrasive cleaners. For hand washing Pilkington **Solar-E**™ glass, a mild detergent and water solution is recommended. Remove any grit particles with an air or water hose. Uniformly apply the cleaning solution to the glass and wash with a clean, soft cloth, sponge, or pad. Rinse thoroughly with clean water and wipe or squeegee dry immediately. Make sure no metal parts of the cleaning equipment touch the coated glass surface, and that no abrasive particles are trapped between the glass and the cleaning materials. Do not use HF (Hydrofluoric) acid, harsh chemical cleaners, abrasives, steel wool, or razor blades on the Pilkington **Solar-E**™ coated surface.

LAMINATING

Pilkington **Solar-E**™ glass can be laminated. However laminating Pilkington **Solar-E**™ glass with the coated surface towards the plastic (pvb) interlayer will result in: a small but noticeable reduction in reflectivity; an increase in transmission; a small change in reflected color; and will adversely change the thermal properties (SHGC and U-Factor) by masking the low-e effect.

It is recommended that each laminator conduct in-house adhesion tests, prior to actual production, to determine if an adequate bond has been obtained when the coating is in contact with the interlayer. The LBNL Optics 5 and Window 5 programs can be used to compute laminated performance with the coating facing air. See Pilkington ATS Bulletin #171.

HEAT TREATMENT

Heating

Pilkington **Solar-E**™ glass can be heat-strengthened, fully tempered or bent, after it is cut to size. (Please refer to ATS Bulletin #177 for bending details) Pilkington recommends that Pilkington **Solar-E**™ glass be properly cleaned and dried prior to heat-treating. The glass should be visibly clean at this stage to eliminate hand prints, fingerprints or other marks, which could be burnt into the surface during heat-treating. The coating can be facing up or down when heat-treating in a horizontal furnace. If the glass is processed with the coating facing down then the furnace rollers must be clean and the glass should not slide on them at any time.

Sulfur Dioxide (SO2) is acceptable for use with this product and does not affect the coating.

As with all low-e coated glasses, when the Pilkington **Solar-E**™ coating, with an emittance of 0.17, is facing up, it will reflect radiant heat and so it will require a longer furnace cycle to achieve the same uniform temperature as uncoated glass of the same tint and thickness. Note that with the coated side facing up, the bottom surface will run hotter and the glass will need to be watched for roller marking or center-rub ('Skunk Stripe' or 'Belly Rub') from temporary, concave surface up, warping.

Coating Facing Down

With the coating facing down, a more rapid heating of the light may be achieved by thermal convection and conduction from the hot rollers to the lower surface, and by more complete absorption of radiation heating to the glass surface on top. However, care must be taken to prevent marking from the furnace rolls, and the load and unload conveyors. The glass should not be slid over stationary machine parts (rollers, castors, etc.) when the coating is facing down. With the coating down, the furnace cycle time will be close to that of an un-coated glass of the same tint and thickness.

If the fabricator is experienced at heat-treating 6 mm (¼") Pilkington **Optifloat**™ tinted Float Glass, then those furnace and quench settings make an excellent starting point for processing Pilkington **Solar-E**™ on tinted glass with the coating down. The effective radiant temperature of the furnace will determine the actual heat transfer to the glass. Individual furnaces will have different heating characteristics. Use a slightly shorter time (about 10 to 20 seconds shorter than the time for clear Pilkington **Solar-E**™ glass).

The high performance tinted Pilkington **EverGreen**™ and Pilkington **Arctic Blue**™ substrate glasses will cause these Pilkington **Solar-E**™ products to absorb heat even faster in the furnace than Pilkington **Solar-E**™ Grey or Blue-Green and so the heating cycle time should be further reduced (about 20 seconds less than the cycle time for Pilkington **Solar-E**™ low-e on clear glass).

Coating Facing Up

A very rough rule of thumb for heating *non-coated*, *clear* glass for tempering is: 1 second in the furnace for each 0.001 inch of thickness. i.e. 6 mm (0.222") glass will require about 3 ½ minutes heating time***. Individual furnace times will differ***.

For Pilkington **Solar-E**™ glass, with the coating facing up, the furnace cycle time may need to be 15%, or more, greater than that for non-coated glass of the same tint and the same thickness to achieve adequate heating.

If the fabricator has no previous experience in heat treating glass, Pilkington recommends a furnace setting of approximately 670°C (1240°F) and a heating cycle time of 240 seconds as the starting point for Pilkington **Solar-E**™ on tinted glass, with the coating facing upwards.

6 mm (¼") Pilkington **Optifloat**™ Grey, EverGreen, Blue-Green, or Arctic Blue tinted glass furnace settings can be used as starting points for those tinted glasses with Pilkington **Solar-E**™ coating. When the coating is facing up, the furnace cycle time may need to be 15% or more, greater than that for non-coated glass of the same tint and the same thickness to achieve adequate heating.

The use of 'aspirators' in a furnace increases forced convection heat transfer and reduces the heating cycle time with Low-E coated glass facing upwards.

Uniform top and bottom surface heating with temperable Low-E coated glass is best achieved with forced convection furnaces.

Remember: the rate of feeding cold glass (individually or in continuous batches) into a hot furnace will have more effect on the glass temperature reached in the heating cycle than the presence or absence of the Pilkington **Solar-E**™ coating.

Since each furnace is unique, individual furnace time and/or temperature adjustments will be required.

Quenching

The forced convection heat loss during the quenching part of the tempering process is little affected by the presence of the coating, though there is some initial difference in radiant heat flow rates from top and bottom surfaces when the glass is hot. This can cause some concave-up shape if the low-e coating is facing up as the top surface will be slower to cool. Normal air flow adjustments may be required to prevent bowing (increase top surface air quench flow for Low-E coating facing up) and to obtain an acceptable break pattern if the glass surfaces are not at exactly the same temperature as uncoated glass of the same thickness.

Optical distortions such as bow, warp, ripple, or roller wave are inherent in all heat-treated glass products. Low-E coated glass can accentuate the magnitude of these distortions. Care should be taken not to overheat Pilkington **Solar-E**™. Overheating Pilkington **Solar-E**™ will cause excessive visible distortion and could damage the coating. If excessive distortion or

coating damage is experienced, a cooler glass temperature during the heat-treating process will be required. This is best achieved by shortening the furnace cycle time rather than changing top and bottom furnace temperature settings. Note that at no time should the glass temperature exceed 640°C (1185°F).

Sample lights of Pilkington **Solar-E**™ should be tested to ensure compliance with applicable safety standards and inspected for distortion prior to starting production. Confirmation that tempered Pilkington **Solar-E**™ will meet or exceed all applicable safety glazing standards is the responsibility of the fabricator.

Note that heat-treated (tempered or heat strengthened) glass can often show a soft dappled shadow pattern, to the naked eye, from the furnace quench air when viewed in polarized (blue sky) light (see ATS #157 for details). The higher daylight transmitting glasses (Clear, Blue-Green, EverGreen and Arctic Blue), with a coating, will show this phenomenon more readily.

BENDING

See Bulletin ATS #177 "Bending PNA Glass" on our website at www.pilkington.com/na for details.

OPACIFICATION

Samples must be viewed for change of coating reflectivity and color when they are opacified on the coated surface.

Water based spray silicone materials, in a wide variety of colors, have been successfully used as opacifiers on the Pilkington **Solar-E**™ coating. As with all construction products, the material supplier should be asked to supply adequate proof of long term durability.

Pilkington **Solar-E**™ glass can have fluorine free ceramic frits or enamels applied to the glass side or the Solar-E coated side. A test piece should be run with the desired frit to ensure satisfactory results. The glass can be successfully processed with the coating facing down provided the furnace rollers are clean and there is no sliding or skidding of the glass on the rollers due to excessively rapid speed changes or travel direction reversals.

SPANDREL GLASS

Pilkington recommends that, in general, glass be heat-treated when used in spandrel applications. Pilkington recommends that for optimum uniformity between vision and spandrel glass, Pilkington **Solar-E**™ spandrels be fabricated by constructing an insulating glass (IG) unit similar to the vision unit, with the coating on the same surface (typically #2) as the vision units, and with a medium to dark grey color ceramic opacifier applied to the #4 surface of the IG unit.

Using heat-treated insulating glass with ceramic enamel on the #4 surface (room-side) will eliminate read-through from the exterior, minimize banding effects, and ensure a stable spandrel design. In order to withstand the high temperatures in spandrel panels the insulating glass sealants used should at least meet a high performance standard such as IGCC Level "A". See: ATS Bulletin #124.

Pilkington acknowledges that a number of factors make it impossible to achieve complete visual uniformity between vision and spandrel glass areas. See mock-up recommendations below.

INSULATING GLASS

When Pilkington **Solar-E**™ glass is used in insulating glass units no edge deletion of the coating is required. Test results to date indicate that Pilkington **Solar-E**™ glass is compatible with typical polysulfide, urethane and silicone IG sealants. The fabricator of Pilkington **Solar-E**™ glass has the ultimate responsibility of testing to ensure that the proper sealant is used for each application. Specific questions concerning compatibility should be directed to, and confirmed with, the individual sealant manufacturers.

STRUCTURAL SEALANT GLAZING

Structural sealant glazing allows for a clean, unobstructed, exterior building appearance when compared to traditional glazing methods which capture the glass edges in a frame.

Because Pilkington **Solar-E**™ Blue-Green, EverGreen and Arctic Blue have higher daylight transmittances, some "read through" of the insulating glass sealant and the structural seal may be more visible under certain lighting conditions when structural sealant glazing systems are used.

GLAZING CONSIDERATIONS

Pilkington **Solar-E**™ products are not intended for use in #1 surface installation. It is generally preferable to glaze Pilkington **Solar-E**™ products with the coating on the #2 surface of single or double glazing.

It will often be necessary to heat treat the outer glass in an IG unit with Pilkington **Solar-E**™ on tinted glass. Please see the Pilkington website Thermal Stress Calculator and the Thermal Stress bulletin ATS #139 for thermal stress calculation methods.

Pilkington **Solar-E**™ Arctic Blue and EverGreen are very high performance glasses and will typically need heat treatment in most IG installations to prevent thermal stress breakage.

MOCK-UP CONSTRUCTION

The construction of a full-scale mock-up is recommended, where the glass can be examined, from both sides, in transmission and reflection. A full-size mock-up, including both vision and spandrel glass, should be constructed and viewed on site, representing the proposed building location and viewing geometry, in all typical lighting conditions, and should be approved prior to final glass product selection and production. This will show the final installed appearance of the glass far better than viewing small hand held samples under interior lighting conditions.

COATING QUALITY SPECIFICATIONS

Uniformity

When viewed in reflection or transmission, as described above, from a distance of 10 feet (3 m), the coating will not have objectionable, bands, streaks or color differences as defined in ASTM C 1376-03. "Specification for...Coatings on Glass". ASTM C 1376-03, Section 6.4.1 states: "Glass within allowable production tolerances may yield differences in reflected color or intensity of light transmittance or both. Perceivable differences are not immediate cause for rejection."

Pinholes

There shall be no single visible spots on the coating greater than 3/32" (2.4 mm) diameter in the outer area, or greater than 1/16" (1.6 mm) dia. in the central area.

Scratches

There shall be no more than 2 readily apparent blemishes in a 3" (75 mm) dia. circle, or no more than 5 in a 12" (300 mm) dia. circle.

Quality Standard of Base Glass

The base glass shall meet the requirements for "glazing select" quality in the ASTM C 1036-06.

Contact Pilkington North America, Inc. Architectural Technical Services, tel: 419 247 4448 for further information.

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