Technical Bulletin

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Bending Pilkington NA, Inc. CVD (Chemical Vapor Deposition) Pyrolytic Coated Glasses:

Pilkington **Activ**™ self-cleaning on clear or blue glass
Pilkington **Eclipse Advantage**™ – solar control low-e on clear or tinted glass
Pilkington **Eclipse**™ Gold – gold color coating on clear glass
Pilkington **Eclipse**™ Sunset Gold – gold color coating on bronze glass
Pilkington **Energy Advantage**™ - low-e on clear glass
Pilkington **Mirropane**™ transparent mirror
Pilkington **MirroView**™ transparent mirror TV Cover glass
Pilkington **OptiView**™ Low-Reflective Glass – low-e coating on clear glass
Pilkington **Solar-E**™ solar control low-e on clear or tinted glass
NSG **TEC**™ Glass– electrically conducting transparent clear low-e coating

Successful Bending of 6 mm (1/4") Pilkington **Eclipse Advantage**™ Clear

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Summary

Pilkington North America, Inc. CVD pyrolytic coatings are composed of thin, very hard layers of metals and metal oxides. They are made by chemical vapor deposition (CVD), in the float bath, of silicon, tin and other metals and metal oxides immediately after the glass has been formed.

The coatings are available with properties of: clear (Low-E); light grey (Solar-E); Reflective or Anti-Reflective; silver or gold colors; Self-Cleaning; and clear electrically conductive; on clear or tinted glass of various thicknesses.

These coated glasses can be heat treated (heat strengthened or tempered) or bent.

BENDING DETAILS

- As most bending is done in slow heat-up ovens (cycle times in hours rather than minutes) the Infra Red (IR) heat reflection property of the low-e coatings is not a significant factor in the heating cycle. For 'high speed' bending furnaces, with cycle times measured in minutes, the low-e coated surface can be placed against clean rollers to allow some heating of that side of the glass plate by conduction to compensate for the reduced radiant heat gain. The high emissivity of the other, non-coated, glass surface will absorb heat from the radiant sources. (Pilkington **Eclipse Advantage**™ Low-E Solar Control coating has been successfully bent in high speed process machines which can simultaneously bend, and fully temper or heat strengthen, the glass.)
- If the low-e coating must be facing away from the rollers in a high speed furnace then more time will be needed to achieve adequate heating because the coating will reject radiant heat. Temporary dishing during heat-up is caused by the bottom surface heating faster than the top surface. This can lead to marking ("center stripe") of the glass side. To avoid dishing, increase the heating rate for the top surface and/or reduce the heating rate of the bottom surface. See ATS Bulletin # 176 "Fabricating Pilkington Eclipse Advantage™ Reflective Low-E" for further details.
- The use of Sulfur Dioxide (SO2) in the bending furnace has no effect on the coatings, and it may help prevent the "center stripe" mentioned above.
- The pyrolytic coatings are thin and flexible (bendable), but do not become plastic at glass bending temperatures so they should not be stretched or compressed. Bending 6 mm (1/4 inch) thick glass to a radius of curvature less (tighter) than about 600 mm (24 inches) will risk creating visible tension cracks or wrinkles in the coating when the coating is on the convex or concave side of the glass respectively, because the coating does not stretch or compress while the glass bends. See photograph below. Thinner coated glass can be bent to a tighter radius.

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- Pilkington CVD coated glasses can be bent singly, or in "doublets" or pairs of lights, with the coating facing against an adjacent light using a thin, uniform (no clumps) protective talc inter-layer. Pairs of lights with the coating(s) facing away from the adjacent light can also be bent. The surface of a mold must be clean or covered with a clean material when the coating is in contact with it.
- In preparing the glass for entry into a bending furnace, it must be carefully cleaned with a hot detergent (Alonox or Basic H are effective) wash, rinsed with clean (preferably distilled or de-ionized) water, totally dried with no drops of water at any edges, and it must not have any visible fingerprints or other marks (vacuum cup imprints, etc.) on the coated surface. Do not let the coated glass surface stop under a rotating washing machine brush because fine marks (sleeks) could be created in the coating. These would be visible in certain lighting conditions such as direct sunlight but may not be visible under factory lighting conditions. Do not use razor blades, steel wool or any other metal objects for cleaning the coating. Don't drag tape measures across the coating, or use unprotected metal objects for handling or moving the glass.
- The furnace settings and cycle times for bending the pyrolytic coatings with no low-e property (Pilkington **Eclipse**™ Gold, Pilkington **Activ**™ and Pilkington **Mirropane**™) should be very similar to those for uncoated glass of the same thickness and tint. Note: Pilkington **Eclipse**™ Gold is on 6 mm clear glass, Pilkington **Activ™** is on clear or Arctic Blue glass, and Pilkington **Mirropane**™ Transparent Mirror is on 6 mm Grey glass while Pilkington **MirroView™** is on 6 mm Clear Glass.
- The glass temperature must not be allowed to rise above 640°C (1184°F) during the bending process. If this temperature is exceeded the coating may be altered, showing areas of uneven and lesser reflection, as well as iridescent colors in reflected light. If excessive distortion or coating damage is experienced, a cooler glass temperature during the heat treating process will be required.

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- Pilkington CVD low-e coated glasses can be bent with the coating facing either up, towards the furnace roof, or occasionally down towards a steel mold treated with a talc protective layer or using a clean heat-proof fiber wool blanket. When the coating is bearing hard against a thermal blanket (coating down on a convex-up mold) a mark can often be found in the initial central contact area. This can be avoided by using a sacrificial light of plain glass underneath the coated glass.
- The low-e coatings have minimal effect on the quenching process when heat strengthened or fully tempered bent glass is being produced. For annealed, bent glass, if the coating is facing the air and not in contact with the mold surface, a slightly slower rate of cooling may be observed due to the reduced radiant heat loss from the glass coating.
- As soon as the hot bending process is completed the glass should be quickly brought down to a temperature of 550°C (1020°F), and then slowly and steadily (26.6°C (48°F) /min for 6 mm (¼") glass) cooled down through about 490 to 455°C (914 to 850°F) for good annealing, then cooled normally to room temperature. Thinner glasses can be annealed and cooled faster, with 3 mm (1/8") glass being cooled about twice as fast as 6 mm (¼") thick glass.
- While the CVD low-e coatings are tougher than vacuum sputtered coatings, they are generally not glazed with the coating on the exposed #1 (exterior) surface, except for Pilkington **Activ**™ Self-Cleaning Glass normally on surface #1, and Pilkington **OptiView**™ Low Reflection Glass which is normally coated on surfaces #1 and #4 of a laminated light. Care should be taken with CVD coated glass to avoid scratches during glass handling and in the bending process. The coated surface should not be allowed to slide in contact with the mold surface.
- The finished product should be examined in Reflection mode, from both sides, for uniformity from a distance of about 10 meters (30 feet) with a dark surface behind the glass, while showing the reflection of an overcast sky or of a uniformly illuminated and featureless light gray color surface. It should also be examined in Transmission and Reflection modes, from both sides, from a distance of 2 to 3 meters (6 to 10 feet), in direct sunlight, or equivalent, for smaller defects.
- Continuous plastic foam or paper sheet interleaving should be used when packing bent, coated glass. If cork or foam tabs are used they should be placed only at the glass perimeter to minimize the possibility of visible abrasions in the glazed product.

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

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