NSG GROUP

Technical Bulletin

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NEW IMPROVEMENTS IN THE APPEARANCE OF INSTALLED Pilkington **Energy Advantage™** Low-E Glass

Pilkington **Energy Advantage**™ is made of an extremely fine polycrystalline hard material that cannot be seen under most lighting and viewing conditions. It is possible to discern the presence of the coating under certain lighting conditions, such as when bright sunlight shines directly onto partly shaded, coated glass and there is deep shade on both sides of the glass.

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Using extreme lighting conditions for the reflected images of a typical window, the residual haze of the older (2010 and earlier) product can be seen in the left hand IG unit of the following photo. A studio spotlight simulates direct sunlight (with the same set-up as in the photo above), and eliminating (with black velvet) the distracting transmitted and reflected images of a typical window, the residual haze of the older (2010 and earlier) product can be seen in the left hand IG unit of the following photo. The IG unit on the right hand side of the original photo below barely shows the miniscule amount of haze that can be found in 2011 production of 2.5, 3.0 and 4.0 mm thick Pilkington **Energy Advantage™**.

Pilkington **Energy Advantage™** pyrolytic coatings are made by the chemical vapor deposition (CVD) process, creating a hard polycrystalline layer of tin oxide over color suppression underlayers. In an electron microscope picture, the polycrystalline structure of the surface of the tin oxide top coat can be seen as a layer of closely packed grains. Daylight can easily pass, with less than 1% scattering, through this coating because each grain is actually smaller than the wavelength of visible light.

The illustration below shows the surface of the coating magnified 20,000 times.

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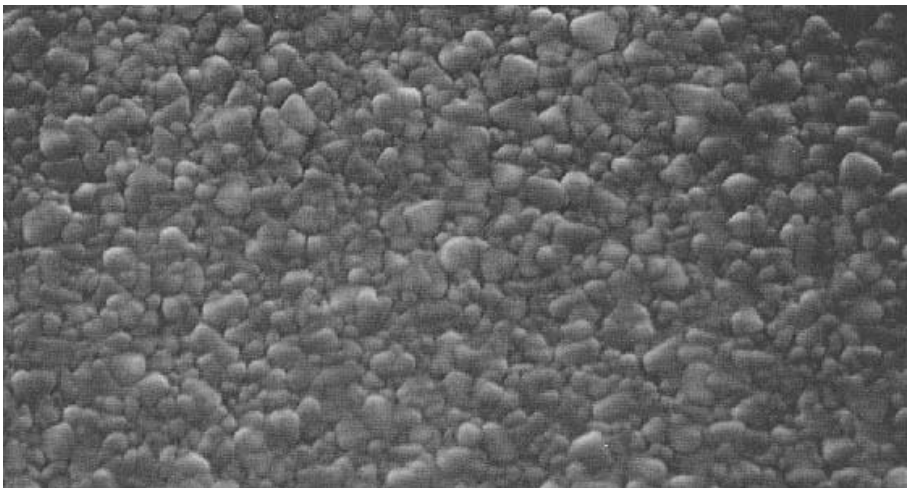

Fig.1. Typical grain structure, magnified 20,000 times.

The extremely small size of the grains makes them invisible in most lighting conditions.

The following electron microscope image shows a cross-section through the Pilkington **Energy Advantage**™ coating. The polycrystalline nature of the coating contrasts with the non-crystalline 'super-cooled liquid' nature of the solid glass underneath the coating.

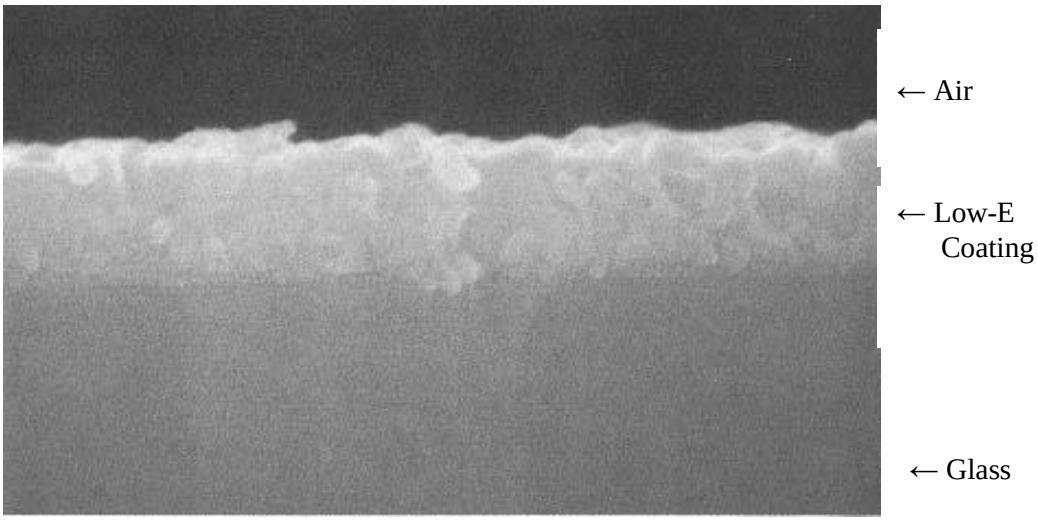

Fig.2. Cross-section showing coating uniformity, magnified 50,000 times.

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It is possible to discern the presence of the coating under certain lighting conditions, such as when bright sunlight shines directly onto partly shaded, Low-E coated glass and there is deep shade on both sides of the glass. When looking out through the glass towards a deeply shaded background, the short wavelength component (blue) of the sunlight appears slightly scattered. This gives the coating a uniform, very faint blue appearance visible in the sunlit area. Longer wavelength red light is less scattered. In the 2003 photo below the haze was made more noticeable by the complete lack of any visible haze in any contrasting glass shaded areas, such as in the diagonal shadow on the glass.

Since this product was first made in 1988 there have been continual manufacturing improvements to its properties. The coating was first made thicker to further lower the emissivity by about 33% from its initial value. At the same time the initial haze of just over 1% was cut in half. Recent (2010) developments have cut this haze value in half again. It is now reduced to a level where it is difficult to perceive under typical installation conditions. In conjunction with significantly reduced haze, its once noticeable blue tint has been eliminated. This results in the final coating being even less perceptible to the human eye.

Haze only becomes visible when its brightness is significant relative to that of the transmitted and reflected images viewed in the glass at the same time. The worst case is when 0.5% of the sun's light (say 10,000 lumens) = 50 lumens, is scattered if the sun is shining through the glass, almost directly into the viewer's eye. This could be easily noticed when compared to the dim light coming from a deeply shaded area, say about 1/1000 as bright as sunlight or 10 lumens. It should be noted that the light scattering (haze) from normal dirt, on an average window before cleaning, is around 1% to 2%, so haze from dirt is far more visible than from the coating, even in the worst case lighting condition described above.

Haze is only visible when direct sunlight shines on the glass. With typical lighting on most Low-E coated windows, and for the greater part of the day, there is no haze visible.

The following photo is an example with no visible haze, even in the sunlit Pilkington **Energy Advantage**™ Low-E Glass (pre 2011 production), because there is no deep shade beyond the glass.

Before a light of low-e coated glass is glazed into a frame, sunlight, or a bright light, shining directly onto the glass cut edge can internally reflect within the body of the glass and produce a series of faint parallel lines a few inches from the glass edge where some reflected light is scattered by the coating. The photo below shows these lines. They are more visible on the left hand side of the glass where there is a dark background behind the glass. This effect completely disappears when the glass edges are shaded by being glazed into a normal sash or frame.

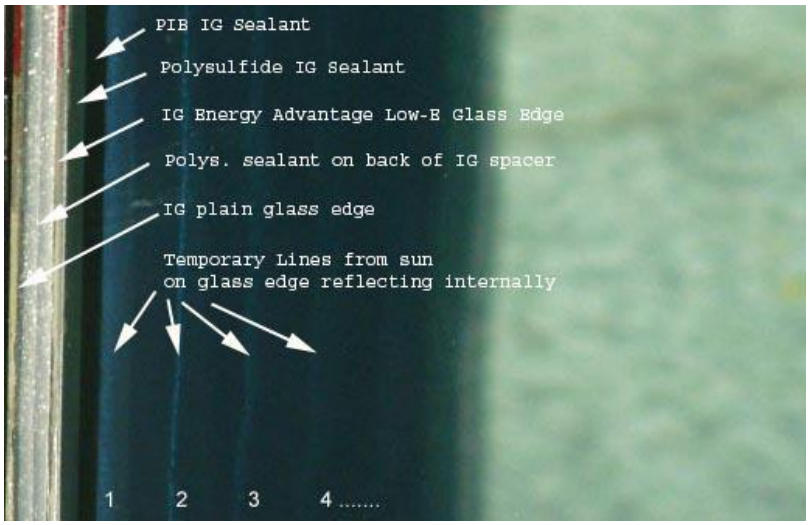
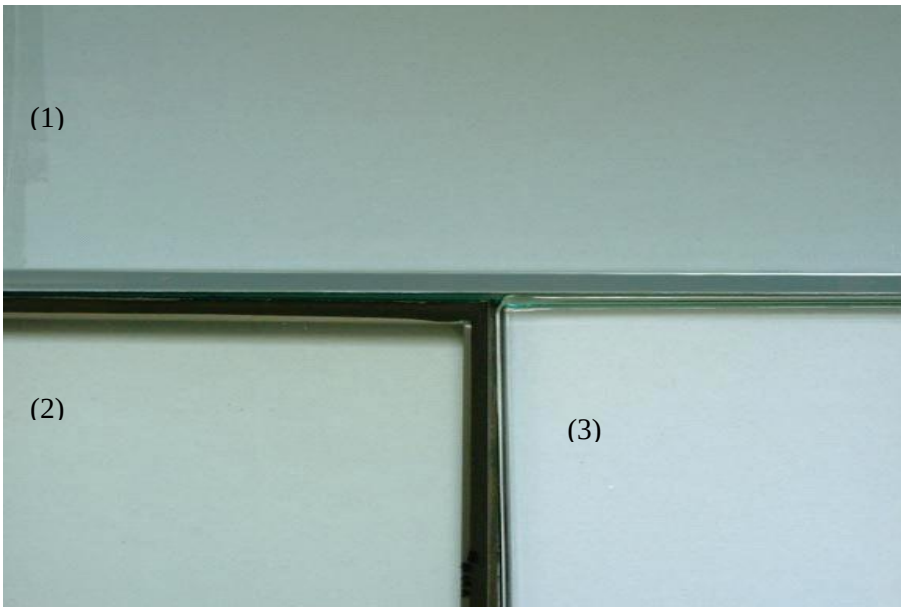


Fig.3. Temporary or Transient Lines caused by sunlight on an exposed glass edge

An alternate way to achieve the very high thermal insulation provided by the pyrolytic 'hard' Low-E coating in a double glazed unit, is to use a 'soft' sputtered coating produced off-line in a vacuum chamber. Such coatings must be protected from humidity by being sealed into an IG unit. The sputtered coating is typically removed or ground off at the perimeter to allow effective insulating glass sealant adhesion. Sputter coatings usually have some reflected color as seen in the left hand glass (1).

Sputter coat IG reflected color of a grey sky. The same sky reflected in adjacent clear glass IG

Viewed in transmission, in the photo below, the top IG unit (1) is sputter coated low-e, the lower left unit (2) is Pilkington **Energy Advantage™**, and the lower right IG unit (3) is clear glass with no low-e.



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The use of three lites of plain glass in a triple glazed unit can also give insulation values similar to a double glazed unit with a low-e coating. But this involves a thicker and heavier window unit, with increased reflectivity, and more distortion in the reflected images when weather changes cause greater expansion and contraction of the wider total air space. There is an increased risk of breakage with improperly balanced air spaces, compared to sealed double glazing.

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

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