NSG GROUP

Technical Bulletin

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Pilkington **Mirropane™** Transparent Mirror Guidelines

Summary

The use of transparent mirrors (often referred to as 'one-way' or 'two-way' mirrors) for security, unobserved observation, and surveillance involves several unique design considerations. A transparent mirror consists of a silver colored, partially reflective, partially transparent coating, usually applied to ¼" (6 mm) thick, grey tinted glass. When viewed from the reflective surface coated side, Pilkington **Mirropane**™ appears to be a normal mirror, provided the light level on the other side is at least 8 times lower. When viewed from the glass side, with the same lighting as above, the viewer can easily observe what is happening on the other, brighter, side without being distracted by masking or veiling reflections.

Pilkington **Mirropane**™ transparent mirror has improved performance properties (it only needs an 8:1 light ratio across the window) compared to the previous (circa 2000) Pilkington **Mirropane E.P.®** product which required a greater difference in light levels (10 to 1) to achieve satisfactory masking and observation performance.

Optical Ratios; Masking and Observation:

All glasses display two images simultaneously: a transmitted image; and a reflected image. This gives a viewer an effect similar to that of a double exposure in a camera. For a transparent mirror application it is generally required to have the glass appear fully reflective from one side, and to be a transparent viewing window, with little distraction from reflections, from the other side. This is achieved by balancing the glass properties of: Reflection (different from each side for a coated product); Transmission; and Relative Light Levels on either side of the glass.

When one of the two simultaneously observed images is at least 50 times brighter than the other one, only the brighter image is perceived. This is the required property on the "Subject" side of a transparent mirror where a "Subject" seeing their reflected image and that of the room, should not be aware of the very faint image of an "Observer" on the other side.

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When one of the images is about 5 times brighter than the other, then the bright image is easily observed with little distraction from the fainter image. This is the required property on the "Observer" side of a transparent mirror where the presence of a faint reflected self-image of the observer is not an issue.

The following formulas apply to any glass type, in any installation. For example, even a single lite of plain clear glass can be seen to act as an effective one way mirror when the room side lighting is 600 times brighter than the exterior light level. This can be sometimes observed on a dark night in a residence with normal interior lighting and where there are no exterior lights.

Two ratios are defined to illustrate the effectiveness of a transparent mirror: the Masking Ratio measures how well the observer's image is hidden; the Observation Ratio measures how easily the observer sees the subject.

Definition of terms used in the diagram:

I_d = Illumination level on the dark side (observer side)

I_b = Illumination level on the bright side (subject side)

T = Light transmittance through the transparent mirror (equal in either direction)

R_f = Film (coated) side reflectance of the transparent mirror

R_g = Glass side reflectance of the transparent mirror

OBSERVER SIDE SUBJECT SIDE

Illumination = Id (Dark) Illumination = Ib (Bright)

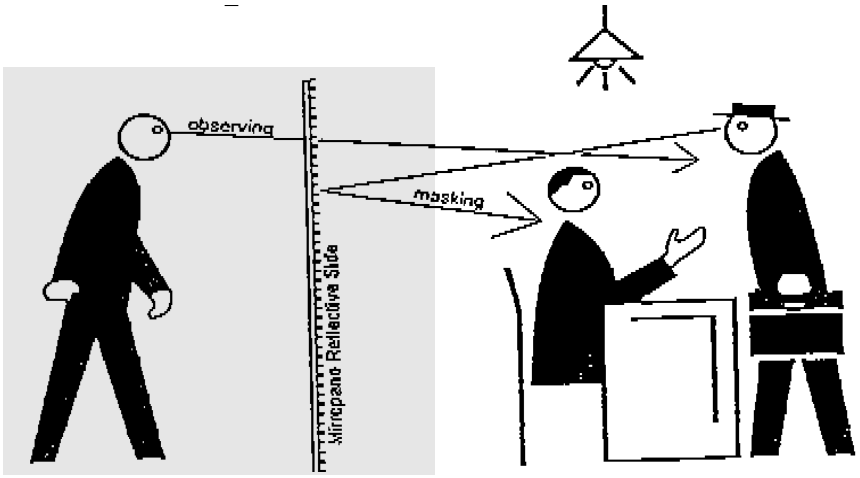

Figure 1

The transparent mirror must be installed with the reflective surface (coated side) towards the subject side. Note also that this side must have the higher level of illumination. The optical ratios are defined as follows:

Masking Ratio: The ability of the transparent mirror to mask, or hide, the observer.

$$\text{Masking Ratio} = \frac{I_b \times R_f}{I_d \times T} \quad \frac{\text{(self-reflection image, as seen by subject)}}{\text{(faint transmitted image, possibly seen by subject)}}$$

Observation Ratio: The ease with which the subject can be observed or seen.

$$\text{Observation Ratio} = \frac{I_b \times T}{I_d \times R_g} \quad \frac{\text{(subject transmitted image, as seen by observer)}}{\text{(reflected image of the observer, as seen by observer)}}$$

*Pilkington **Mirropane™** Transparent Mirror Performance*

Pilkington **Mirropane™** has been designed with the following characteristics to give optimum performance (these values are as published in LBNL program Window 7.7, IGDB Library V67):

Transmission in either direction (T)	Film (coated) Side Reflection (Rf)	Glass Side Reflection (Rg)
0.10	0.75	0.19

The formulae give the following Masking and Observation ratios for 8:1 light level.

	Pilkington **Mirropane™**
Masking Ratio	62
Observation Ratio	4

These numbers indicate that with an 8 to 1 light ratio, the reflected image of the subject is 62 times brighter than the transmitted image of the observer and hence it will be nearly impossible for the subject to perceive the image of the observer. The observer will see an image of the subject over 4 times brighter than their own reflection and will not be distracted by the observer's own faint reflected image.

Application

A successful two-way mirror application involves the careful use of light levels, direct and indirect illumination, and fabric and wall color choices.

Light levels

A minimum 8 to 1 light level is recommended and should be adhered to if possible. Less critical applications may allow lower ratios but the masking and observation properties will be diminished.

Pilkington **Mirropane™** has improved properties which allow a wall to be completely glazed, from floor to ceiling. With no illumination on the dark side, the light coming through the glass from the bright side will automatically create a 9 to 1 light ratio.

Where an 8 to 1 light ratio cannot be achieved, an additional light of grey glass can be added, to the glass side of the transparent mirror, by either multiple glazing or lamination, to obtain a satisfactory Masking Ratio. This will however, reduce the brightness of the observer's image of the subject.

Type of Lighting

Subject side lighting should be bright and evenly distributed over the subject and all walls and furnishings, but should not shine directly onto the transparent mirror. Beyond this, lighting may be consistent with decor and function of the room. The intent is to brighten the reflected image seen by the subject.

Note: do not shine subject side lights directly onto the glass because they will only shine through the glass and illuminate the observer and the dark observation room behind the transparent mirror.

Observer side lighting should be dim with no open light sources (such as unshaded high intensity desk lamps), or reflections from bright objects such as chrome furniture, potentially visible by the subject in a direct line of sight through the transparent mirror. Opaque lamp shades on the observer side are recommended for best results.

Background Colors

Subject side decor should be bright and light in color or shade to create a bright reflected masking image.

Observer side decor should be subdued, dark and uniform. Patterns should be minimized in favor of plain materials.

Bright reflecting chrome furnishings should not be used on the observer side.

Distances

Note that if the subjects are very close to the transparent mirror, less than 2 ft. (600 mm), it may be easier for them to see an observer especially if the observer is also very close to their side of the transparent mirror. On the observer side, it is important to keep people, objects and light sources (such as lamps, flashlights or lit cigarettes) as far back as possible from the transparent mirror area.

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Typical Installations

Figure 2 Airport Security. Baggage Inspection

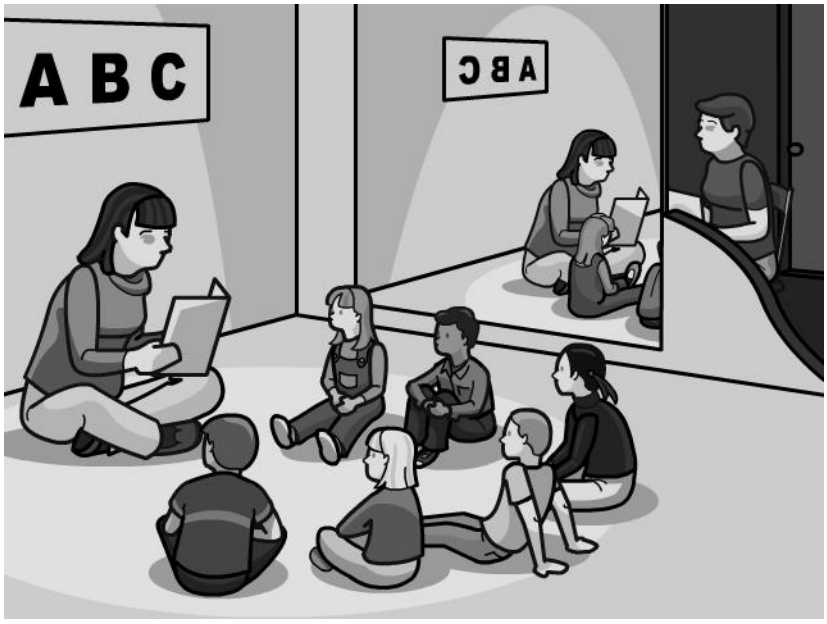

Figure 3 Day Care Center

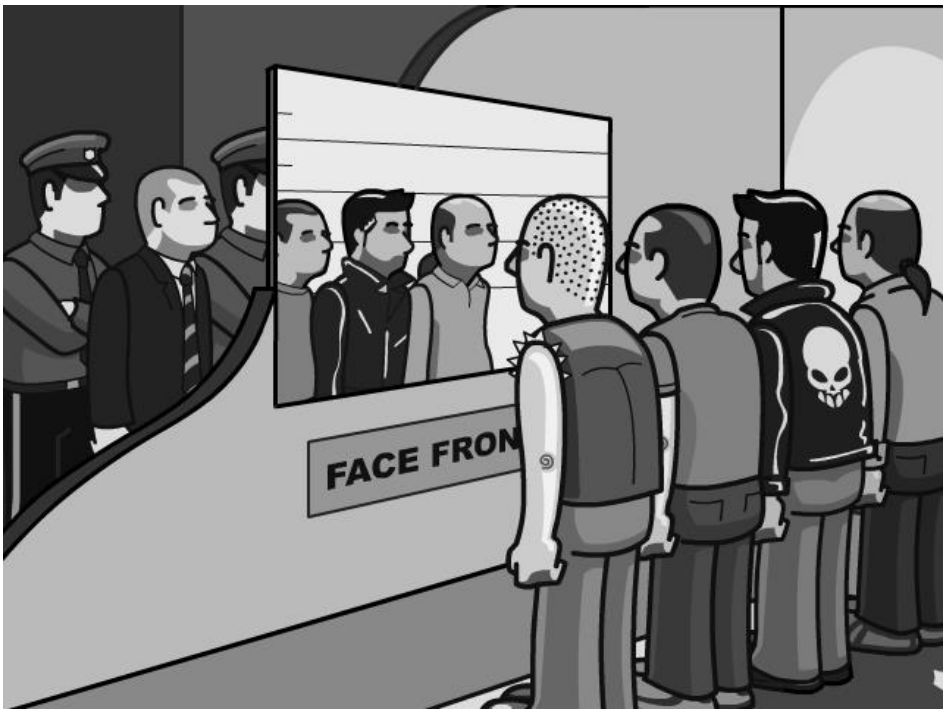

Figure 4 5.3 Police Identification Line-up

Figure 5 Retail Store Anti-Theft Monitoring

Figure 6 Airport Security. Immigration

Safety

Pilkington **Mirropane**™ can be tempered for safety glazing or increased impact resistance. The emissivity of the coating is the same as that of glass. Tempering furnace settings and quench flow rates should be those used for ¼" (6 mm) thick Pilkington **Optifloat**™ Grey glass.

Pilkington **Mirropane**™ can be laminated as long as the coated surface is to the outside of the laminated assembly. Note that Laminating can change the optics, and hence the Observation and Masking Ratios. Laminating with the coating against the interlayer would have a "wetting" effect which would reduce the reflectivity and increase the visible transmission.

Maintenance

Pilkington **Mirropane**™ has a pyrolytically deposited hard coating. It has significantly better scratch and abrasion resistance than vacuum coated products. Routine cleaning should make use of standard glass cleaners or mild detergents. Stubborn deposits may be removed by a one-time gentle use of a cerium oxide solution. Do not normally use abrasives or opaque liquid cleansers. Never use steel wool, razor blades, or Fluorine or acid-based cleaners.

Exterior Glazing

Pilkington **Mirropane**™ is not intended for use in first surface exterior glazing applications (coating to the exterior). In such installations the coating would not become dirtier from natural weathering any faster than ordinary glass, but because of its high reflectivity it would show the dirt faster and so would need more frequent cleaning to preserve a bright, clean appearance.

Pilkington **Mirropane™** is not intended for use in exterior glazing. Installations such as large curtain walls or structural glazing could reveal a slight non-uniformity of coating which would typically not be perceptible in interior applications. A thermal stress analysis should be performed where the glazing will be exposed to direct sunlight.

Sealant Compatibility

Pilkington **Mirropane**™ has been shown to be compatible with most construction and insulating glass sealants. Contact sealant manufacturers for details.

Sample Specification

"All transparent mirrors designated on the drawings shall be Pilkington **Mirropane**™ glass in the sizes noted. The reflective coated glass shall meet the performance specifications as published by the manufacturer. The transparent mirror shall be installed with the coated surface facing the observed or subject side of the glazing. A light level ratio of at least 8 to 1 from bright (subject) side to dark (observer) side shall be maintained for effective operation."

Summary	Editor	Date
Original	C. Barry	01/14/13
Remove standard reference in "Sample Specification"	K. Natividad	06/20/22
Clarification of External Application suitability; update IGDB values	K. Natividad	04/18/24

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