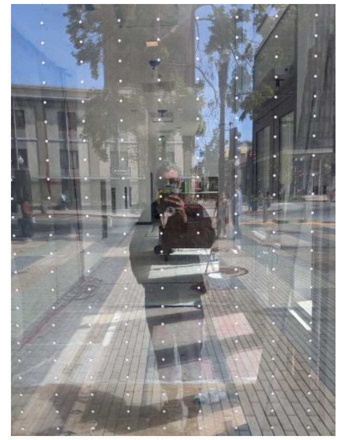
Bird-friendly glass measurement documentation

Jacob C. Jonsson, jcjonsson@lbl.gov, https://windows.lbl.gov

Introduction



Bird glass, a.k.a. bird-friendly or bird-safe glass, is a term covering a group of products targeted at reducing the number of birds that fly into windows. A common solution is to have a pattern of dots or stripes that allow the birds to interpret the window as an obstacle.

IGDB has had a rule that all products are to be homogeneous over the surface, i.e. the properties measured at any point of the surface would be the same as at any other point. This prevented any product with a pattern from being included. Bird glass products are now being exempt from this rule on a case-by-case basis and this document is aimed at providing transparency on how the products are being reviewed and what extra level of measurement is expected to allow patterned products in.

Goal

The ambition is that IGDB rules should not prevent bird glass products from being excluded as an option in window construction. Allowing for accurate performance data to be used when modelling or certifying a window is beneficial for the manufacturer and consumer. It is preferable to avoid a situation were the only options are to be using the performance of the substrate glass and/or using aftermarket products to add decals on the glass to achieve the bird safe effect without learning about the impact on VT and SHGC.

Current principles for inclusion

The best way to justify inclusion is to demonstrate that the impact of the pattern on the substrate is very small. Obtaining the properties for 100% covered glass and the substrate properties as well as the area covered by the pattern allows for calculation of the compound properties for a product with any percentage coverage, which also allows for easy comparison with the substrate to show the impact of the pattern.

Why was IGDB set up to not include patterned glass in general? There are at least three arguments that contributed to the decision:

1. The complexity in measuring patterns where the pattern is of the same order of magnitude as the beam size or of random nature. These cases can result in a large variation of measured properties depending on where on a sample the optical properties were measured. Increasing the number of measurements, with sample dependence dictating how many measurements would be required to reach a representative result, was challenging to define for the general case.
2. The impact of a regular pattern could depend on the size of the pane, resulting in the same IGU build to have different properties for different size windows.
3. The interaction between patterns (and with themselves) when doing multi-layer calculations at oblique angles of incidence would require detailed geometrical information about the product

to do accurately. For systems where multiple layers have patterns the same problem also crops up at normal angle of incidence. There is precedence for ignoring this effect with the Venetian blind model used in WINDOW where the geometry is ignored and the layer is treated as homogeneous over the surface, with each point having the scattering behavior of the macroscopic product.

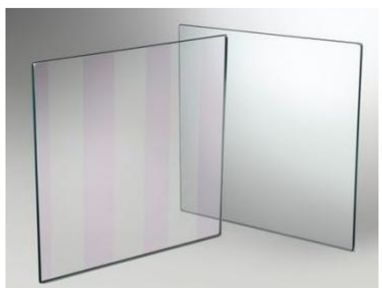
Examples of products that have been included and the measurements carried out to justify inclusion and calculation of representative values

To prepare submitters what level of scrutiny to expect for their product these are examples of what has been included and what data was measured and demonstrated.

UV-reflecting stripes

This was striped product with a single fixed geometrical pattern (no options or variants). Spectral transmittance and reflectance data was provided for the coating and uncoated substrate. Mathematical average between the two where the coated was area-weighted with the coverage percentage of the pattern resulted in representative spectral data. The table below show integrated values for the measured values and the representative values used for the listing.

Coverage	Tvis	Tsol
0%	0.6666	0.2392
Listing	0.6673	0.2395
100%	0.6687	0.2400



Credit: Guardianglass.com

Reflecting laminated dots

A laminated product with highly reflecting exterior surface and low reflecting interior surface was incorporated through dots covering less than 1% of the surface area. A sample was created with 100% coverage and the reflectance was measured using the procedure defined in NFRC 300 for diffuse products. Even though the dots were scattering it was approximated as a specular sample and included in the IGDB instead of the CGDB. With the product designed to be layer 1 in an IGU (or the only layer) scattering contributes minimal impact on the multiple reflection calculation. Having a reflective component in the interlayer prevented it from being deconstructable in Optics and each laminate build has to be submitted as its own product into the IGDB.

Cover	Tv	Ts	Rfv	Rfs
0%	0.881	0.725	0.098	0.083
Listing	0.887	0.720	0.104	0.088

Credit: Saflex.com

Gradient stripes

A visible coating with gradient thickness is an example of a more complicated challenge. The manufacturer measured the sample with small beam in multiple spots showing the maximum, minimum and intermediary transmittance and reflectance spectra. Since they had intimate knowledge of the gradient of the coating they were able to make a good estimate of the total product value based on a weighted average of their multiple measurements. In addition to this an external test lab using a spectrophotometer with a large illuminated area (set to match exactly one period of the gradient stripes) confirmed the properties calculated from multiple measurements.

Cover	Tvis	Tsol
min	0.893	0.828
Listing	0.822	0.773
max	0.682	0.674

Credit: PilkingtonTV at youtube.com

First surface acid-etched features

This product has acid-etched features (dots, squares, lines, etc.) on the exterior surface of the glazing, with most patterns having coverage of 1% or less, but some are higher. Two samples were cut from a custom-produced single large piece of glass that had only a portion of the surface with 100% acid-etched coverage. This resulted in the exact same substrate glass without variation, with one sample having a 100% acid-etched surface and the other sample having no etch. Both samples were measured using the procedure defined in NFRC 300 for diffuse products.

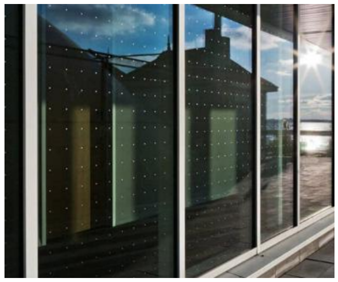
Various IGU configurations were considered using the full diffuse glazing characterization area-weighted for coverage area, and the 7% coverage case resulted in differences of no more than 0.006 for SHGC, Ts, Tv, Rs, or Rv. With such limited impact it is reasonable to represent products with these first surface acid-etched features up to coverage levels of 7% with the data for the corresponding product without the features and include these products in the IGDB.

Note that the process of acid etching can result in more or less impact on the surface, and this example is not representative for all acid-etched treatments.

Data for single pane:

Coverage	Tv	Ts	Rfv	Rfs
0%	0.893	0.807	0.083	0.073
1%	0.893	0.807	0.083	0.073
7%	0.892	0.806	0.082	0.073
100%	0.886	0.795	0.078	0.069

Credit: www.walkerglass.com



First surface laser-etched features

This product has laser-etched features (dots, squares, etc.) on the exterior surface of the glazing, with a common pattern having about 1% coverage. Two samples were cut from a custom-produced single large piece of glass that had a portion of the surface covered with tightly packed 20mm diameter etched dots, which were large enough to fit the entire measurement beam of the spectrophotometer. This resulted in the same substrate glass without variation, with one sample having an illuminated area of solid etch and most of the surrounding area etched and the other sample having no etch. Both samples were measured using the procedure defined in NFRC 300 for diffuse products, except that the etched sample was not fully covered. However, since the measurement beam was within an etched circle for all measurements, this is a good enough representation of the optical properties to estimate the results for a low area-weighted coverage level.

Various IGU configurations were considered using the full diffuse characterization area-weighted for coverage area, and the 6% coverage case resulted in difference of no more than 0.005 for SHGC, Ts, Tv, Rs, or Rv. With such a limited impact it is reasonable to represent products with these first surface laser-etched features up to coverage levels of 6% with the data for the corresponding product without the features and include these products in the IGDB.

Data for single pane:

coverage	Tv	Ts	Rfv	Rfs
0%	0.882	0.779	0.081	0.071
1%	0.882	0.779	0.081	0.071
6%	0.881	0.778	0.080	0.071
100%	0.857	0.758	0.071	0.059

Moving forward with bird glass in the IGDB

Products will keep being reviewed on a case-by-case basis to make sure that they can get a fair representation in the database. Once a better understanding of the range of different solutions used to create bird glass is reached it should be possible to write more general directions.

Is there a timeline for IGDB to include the bird glass Material Threat Factor (TF)?

No. There are currently no plans to incorporate this information. Test centers like the Powdermill Avian Research Center (PARC) and the Hohenau-Ringelsdorf bird ringing station in Austria do testing of products with respect to how well they prevent bird collisions. This is outside the permit of LBNL and the IGDB and it would be an extra burden on peer reviewers to review these metrics.