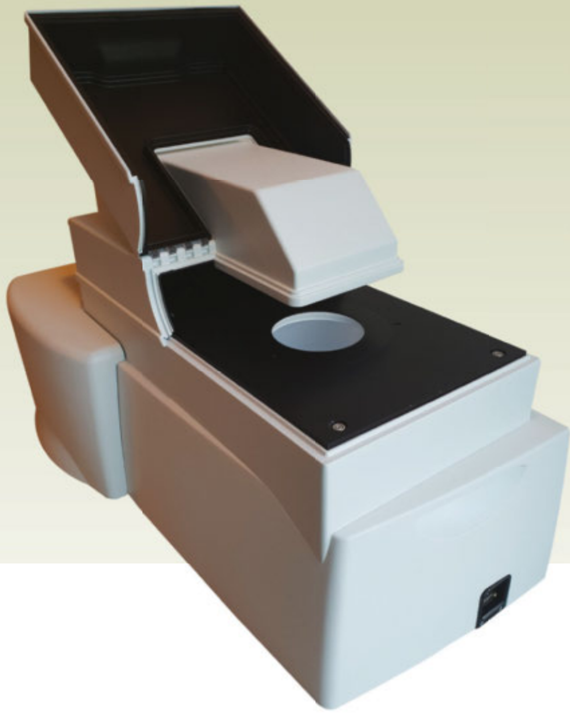
LAMBDA 1050+

PRODUCT NOTE

UV/Vis Spectroscopy



Key Features:

- Unique accessory for accurate measurement of reflectance and transmittance
- Patterned cover glass (solar cells) or textured/coated glass (buildings and greenhouses)
- New sphere design eliminates causes of many common errors
- Compatible with PerkinElmer LAMBDA 1050+ UV/Vis/NIR spectrophotometer

Trusted Glass Measurements for Better Product Development

Glass industry and glass testing laboratories that develop and manufacture high-efficiency solar cells, diffuse glass for optimized light distribution in greenhouses, and light-diffusing glazing need the ability to accurately measure the transmission and reflection properties of these materials. They are also legally required to prove their products meet essential glass regulations such as NFRC, EN, ISO, CIE to comply with industry standards.

A standard tool for the optical characterization of glazing is a UV/Vis/NIR spectrophotometer equipped with an Integrating Sphere unit. A lack of trust in these instruments or inaccurate measurements can result in inadvertently submitting wrong data and lead to losing certifications and customer trust - adversely impacting business. Integrating Spheres are designed for measurements of light-redirecting and light-scattering glazing samples. However, the present commercially available integrating spheres are not really suitable for accurately measuring the transmittance of these products.

The PerkinElmer UL270 integrating sphere is a unique accessory that allows new accuracy to be achieved in the measurement of light-diffusing materials and adequately solves the various measurement problems involved in measuring transmittance and reflectance of light-redirecting and light-scattering samples discussed in detail.

PerkinElmer
For the Better

The UL270 integrating sphere accessory is available for the PerkinElmer LAMBDA™ 1050+ UV/Vis/NIR spectrophotometers. Don't just take our word for it, read the evidence for yourself in the studies carried out and published by Peter A van Nijnatten, Jurgen de Wolf, Rupert Aries and Patrick Courtney. Their examinations concluded that the integrating 270 sphere greatly increased accuracy by eliminating many of the common error causes.

The use of light-diffusing samples such as patterned cover glasses used in solar cells and textured/coated glasses used in buildings and greenhouses is increasing.

The ability to accurately measure the transmission and reflection properties of these materials is a key requirement in the development and manufacture of high efficiency solar cells and light-diffusing glazing.

Integrating spheres are widely used for the reflectance and transmittance of light-diffusing samples. For many applications including diffuse reflection measurements small sphere accessories are an excellent choice. However, the increasing demand for accurate diffuse transmittance measurements of light-diffusing materials poses a challenge for smaller spheres.

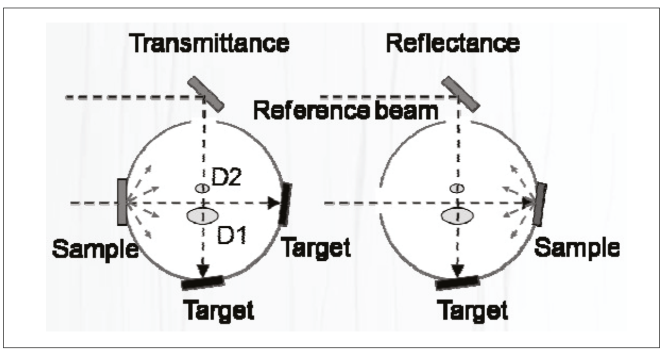


Figure 1. Configuration of a typical 150 mm integrating sphere. D1 and D2 are the UV/Vis and NIR detectors.

Sources of Error

We identified four major problems in measuring transmittance of patterned and diffusing glazing with regular 150 mm integrating sphere, related to:

1. The limited port size
2. Difference in target reflection and average reflection of the sphere wall
3. Improper screening (baffles)
4. Limited beam size (compared to pattern size)

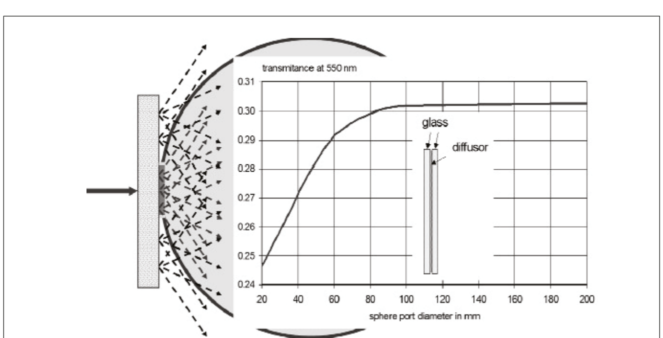


Figure 2. Effect of the port diameter on the measured transmittance of a glass laminated diffuing foil.

For accurate transmittance measurements a sphere with a transmission port as large as 100 mm may be required to capture all the transmitted light of a diffusing sample.

For light scattering samples like for instance "frosted" glass or laminated glass with a diffuse foil between the glass panes or glass, The port size error is dominant and for these types of samples the measured transmittance is largely underestimated, sometimes even up to 20% of the true value.

For light redirecting samples like patterned glass the other types of error are dominant resulting in an overestimated value of the transmittance (≈1%– 2%).

Another problem with measuring patterned samples is related to a relatively small beam size which is usually wavelength dependent when measuring in the NIR, causing a step in the spectrum at the wavelength where the detector switch occurs.

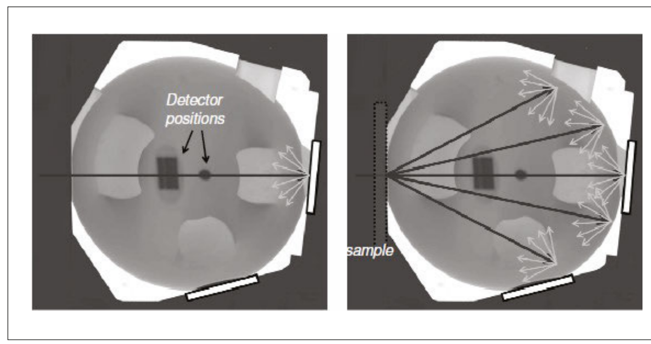


Figure 3. Inside view of a standard 150 mm integrating sphere, showing the positions of the baffles.

Our New Integrating Sphere Design

Schematic drawings of the new sphere design are shown in the figure below. The Spectralon™ integrating sphere has an internal diameter of 270 mm The single horizontal (upward-facing) port facilitates measurement for large samples.

Using inserts, a 50 mm or 100 mm port size can be selected. The 50 mm port size is sufficient for patterned glass and results in the lowest measurement noise, whereas the 100 mm port size, although yielding a lower detector signal, provides the most accurate values on scattering samples.

The sample is illuminated by a circular 20 mm diameter beam that is constant for all wavelengths, providing adequate pattern sampling to ensure representative spectra.

Measurements

The figure below shows a comparison of measurement results obtained on two samples with three different set-ups. Sample a) consists of two 4 mm clear flat glass samples laminated with a diffuse PVB foil. Sample b) is a 6 mm flat glass sample with a ceramic frit on one side.

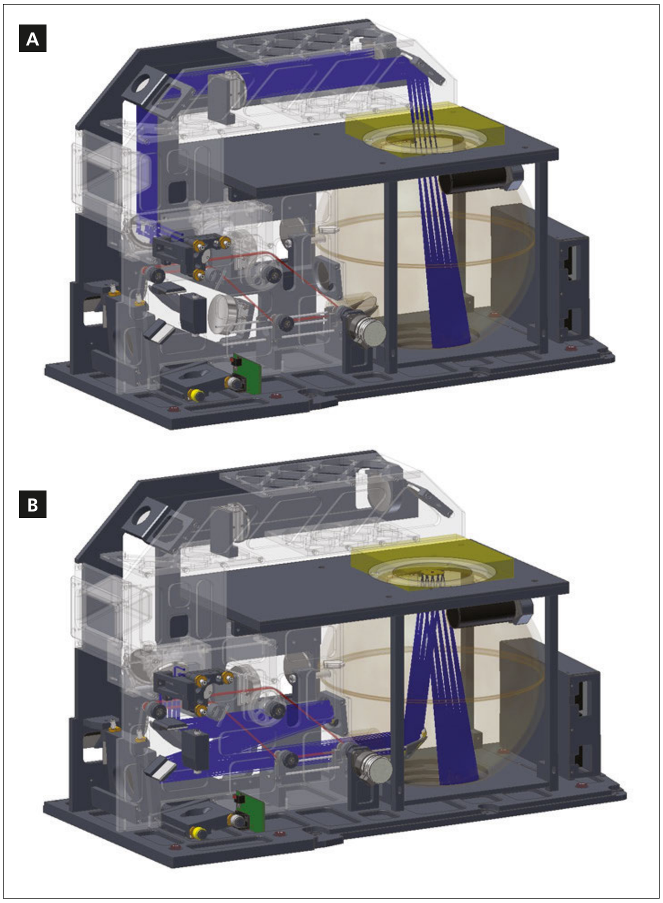


Figure 4. Schematic drawing of the new sphere design. Figure 4a. Transmittance and Figure 4b. Reflectance.

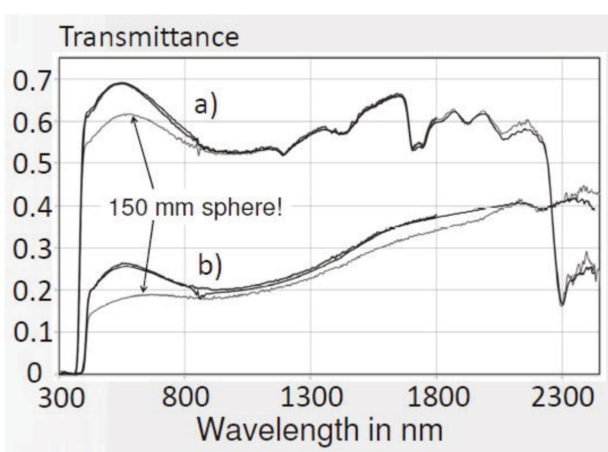


Figure 5. Inside view of a standard 150 mm integrating sphere, showing the positions of the baffles.

The curves in grey represent the measurements performed with a Standard 150 mm integrating sphere on a PerkinElmer LAMBDA 1050+ UV/Vis/NIR spectrophotometer. The black curves up to 2500 nm were obtained with the same spectrophotometer equipped with our 270 mm upward looking sphere. The black curves up to 1800 nm were obtained with a large 630 mm BaSO4 coated integrating sphere with UV/Vis and NIR diode array spectrometers and a broadband light source to illuminate the sample.

Results obtained for a solar cell cover glass are listed in the table below.

Table 1. Transmission "piramid" paterned glass.

Sample Production Date	270 mm Sphere, 3.2 mm Sample as is	150 mm Sphere, Sample Polished and Grinded and Corrected to 3.2 mm
05/12/2008	91.18%	91.08%
07/05/2008	91.26%	91.03%
10/05/2008	91.26%	90.77%
10/05/2008	91.26%	90.89%

Figure 6. Photograph of our new 270 mm upward looking integrating sphere installed in the LAMBDA 1050+ spectrophotometer.

Conclusion

The nature of the systematic errors involved in using integrating spheres for measuring diffuse transmittance where identified and a new sphere was designed to avoid or minimize these errors. A comparison of measurements on diffuse transmitting samples clearly demonstrate that the results obtained with the standard 150 mm sphere are inaccurate while the results obtained with the new 270 mm sphere agree well with the results of the much larger 630 mm sphere.

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