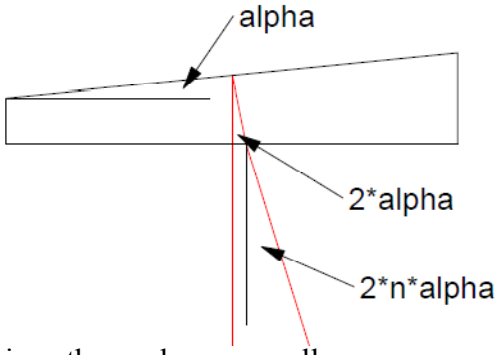
PSM Application Note

Measuring wedge in a window

One of the easier measurements to make with the PSM is the wedge in a nominally plane, parallel window. Since the PSM is an autocollimator when the objective is removed, the collimated beam is pointed at the window in question. With the PSM source turned up to the MAX mode, the beam reflected from the window is easy to see against a white sheet of paper under normal room lighting. The window is then tilted until the reflected beam goes back into the aperture in the front of the PSM. Once the beam hits the aperture the focused spot is visible on the video screen. On turn the source down to MIN, and adjust the shutter speed.

If the window has any measurable wedge there will be two spots on the screen, one from each side of the window. The distance between the spots is proportional to the wedge and the angle of the line between the spots indicates the direction of the wedge. The figure below shows how to calculate the wedge in the window.



Without loss of generality, since the angles are small, we can assume the incoming beam hits the first surface at normal incidence and is therefore not refracted. After reflection off the back surface the beam heads for the front surface deflected by twice the window wedge, alpha. Once the beam strikes the front surface it is refractive away from the normal at an angle 2*n*alpha.

To find out what 2*n*alpha is we have to know the index of the window, n. Also, we have to know how far apart the spots are in terms of pixels in the camera. The “arrow” tool, or cursor, shows the x and y coordinates of the pixel it is positioned over in the video screen. Taking the differences in x and y and then taking the root sum square we get the separation of the spots in pixels. Pixel sizes vary with camera but the Point Grey Research web site http://www.ptgrey.com will give this information for the camera on your PSM. A typical value is 4.65 µm per pixel.

Say we find a 13 pixel separation and the efl of the PSM tube lens is 100 mm. Thus the angle is (13*.00465)/100 = 605 µradians ≈ 126 arc seconds ≈ 2 arc minutes. If n = 1.5, then the wedge angle is 605/2*1.5 = 202 µradians ≈ 45 arc seconds, a very typical wedge in the window.

Notice that if the window is better than 3 seconds of arc, it will be difficult to get a measure of the wedge because the two spots will be less than 1 pixel apart. To find the direction of the wedge, moisten the rear side of the window with water or alcohol. The spot from the rear surface will dim or disappear. Once you know which spot belongs to which side of the window it is easy to figure out which is the thick side of the wedge.