



Refractive Index Measurement

Overview:

The refractive index of a material has a significant effect on lens design. This is since the required refracting power of a lens is directly related to its refractive index and determines the thickness and curvature of the optical device. The thickness of the optical device is important for both contact lenses and intraocular lens applications. For example the oxygen transmissibility of a contact lens is calculated by dividing the oxygen permeability of the material by the thickness of the lens. Thus a thicker lens will result in a decrease in the oxygen transmission through the lens. The refractive index of a material can be measured as detailed in the following standard.

ISO 18369-4:2006 Ophthalmic Optics - Contact lenses - Part 4: Physiochemical properties of contact lens materials.

Specifically section 4.5 Refractive index. The refractive index is determined by measuring the critical angle of incidence for total internal reflection of light of wavelength 589.3 (sodium d-line) using a calibrated Abbe refractometer at a controlled temperature. Light passes from the prism surface of the refractometer into the contact lens material. The critical angle is related by Snell's Law to the refractive index of the flat specimen tested and of the transparent flat reference surface of the refractometer, upon which the test specimen is placed during measurement and is calculated using the following equation.

$$n = \frac{n' \sin(\theta)}{\sin(90^\circ)}$$

where

n is the refractive index of the test specimen

n' is the refractive index of the reference sample

θ is the critical angle of incidence upon the reference surface

It is necessary to use a contacting fluid between the contact lens material and the refractometer prism for all materials except hydrogels. The contacting fluid should have a refractive index greater than that of the test specimen and should not be harmful to the test material of the refractometer prism assembly.

Procedure:

Test samples should be flat or capable of being flattened against the reference surface of the refractometer during measurement. The test surface placed against the reference surface should be polished to a smooth finish. Hydrogel specimens should be equilibrated in saline prior to measurement, then lightly blotted to remove excess water from the surface immediately before testing. In the case of hydrogel materials and soft non-hydrogel materials contact lenses can be used as test specimens.



It is important to ensure that the refractometer has reached equilibrium with the ambient temperature. For non-hydrogel materials a drop of contacting fluid is placed on the refractometer prism and the specimen is then pressed firmly against the prism. For hydrogel samples the contacting fluid is not required. Satisfactory contact between the test sample and the prism is indicated by a sharp and straight dividing line appearing between the light and dark portions of the field of view. If the sample is not pressed sufficiently firmly against the prism, a faint secondary line may be seen somewhat removed from the sharp line. This is caused by the hydrating fluid and will give a refractive index of 1.336.