

# Characterizing the surface properties of a contact lens: A review

Terms like *wettability*, *lubricity*, *contact angle* and *coefficient of friction* are often used in describing interactions between a contact lens and the eye. What do these terms mean and how do they relate to contact lens comfort?

## Lubricity, friction and coefficient of friction

Contact lens-related discomfort and dryness are linked to the interaction between:

- The posterior surface of a lens and the corneal surface,
- The anterior surface of a lens and the lid (during a blink).

Friction is the force that prevents one of these surfaces from sliding comfortably over the other, and is quantified by a simple index called the *coefficient of friction*.

Lubrication reduces friction. Lubricity has an inverse relationship with the coefficient of friction of a surface (if the coefficient of friction of a lens is low, its lubricity will be high).

Lubricity plays an important role in comfort by reducing stress on the conjunctival tissue of the ocular surface. Methods of measuring the lubricity of contact lenses (see Figure 1 for an example) have yet to be standardized, but all involve two key measurements:

A - The force required to initiate and/or sustain sliding (of one surface over another)

B - The force holding two surfaces together.

Coefficient of friction is calculated by dividing A by B.

## Wettability and contact angle

Wettability refers to the ease with which a liquid spreads over the surface of a contact lens. This property can be evaluated qualitatively in a clinical setting, by observing the interaction between tears and the lens surface. In a laboratory setting, wettability can be quantified by measuring the angle between the lens surface and a drop of liquid (see Figure 2).

The more hydrophilic a lens, the lower its contact angle – and the more wettable it is. The more hydrophobic a lens, the higher its contact angle and the less wettable it is.

An advancing contact angle is measured when liquid is dropped and spreads onto the surface of the lens. It represents the re-formation of the tear film layer over an un-wetted contact lens surface (i.e. after the blink).

A receding contact angle is measured when the drop is pulled back into the instrument, and is an indicator of how the tear film breaks on the lens surface between blinks.

### Definitions at-a-glance

**Friction** – Force that prevents one surface from sliding over another surface.

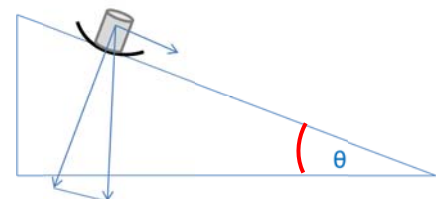
**Coefficient of friction** – Index that quantifies friction

**Lubricity** – Quality that reduces friction (and so has an inverse relationship with coefficient of friction)

**Wettability** – The ease with which a liquid spreads over the surface of a contact lens.

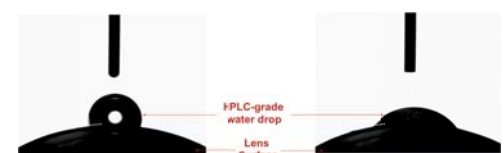
**Contact angle** – A means of quantifying wettability by measuring the angle between the lens surface and a drop of liquid.

Fig 1: Inclined plane method of measuring the coefficient of friction of a contact lens



Determine the critical angle needed to maintain the movement of a weighted contact lens. Kinetic coefficient of friction is the tangent of the largest angle where the lens is unable to maintain movement.

Fig 2: Sessile water drop method of measuring contact angle.



High contact angle  
- poor wettability

Low contact angle  
- good wettability