Procedure Name.

Universal Optical Equation.

Procedure Description.

A brief description of the Universal Optical Equation as used in LDS3 and the "Form Talysurf"

Supplementary Documentation.

Shapes.exe program.
Shapes.dat data file for the Shapes.exe program.
Shapes.exe users manual.
Optoform Job File Format.

Procedure Details.

The Universal Optical Equation is a general equation for describing the sagital depth of a conic section as well as polynomial modified conic sections. These surfaces include lines, spheres, prolate ellipse, oblate ellipse, hyperbola, parabola, and modified versions of the above using polynomials.

For the Optoform job file, the form of this equation is convenient, as the job file is also a sagital description. (See the Optoform Job File Format Description).

With contact lenses, the most common used surfaces are the sphere (e value of zero) and the ellipse (e value of greater than 0 and less than 1). The problem with the e value is that it will only describe the prolate ellipse, (in contact lens terms a surface that gets flatter from center to edge). But not the oblate ellipse, (a surface that gets steeper from center to edge, that may be used in Ortho-K lenses for example).

Thus for the Universal Optical Equation we introduce the k value. The k value has the following characteristics:

A k value of greater than zero describes an oblate ellipse.
A k value of zero describes a sphere.
A k value of less than zero but greater than –1 describes a prolate ellipse.
A k value of –1 describes a parabola.
A k value of less than –1 describes a hyperbola.

The k value can be converted from the e value directly by using $k = -e^2$.

The following shows the form of the Universal Optical Equation.

$$z = \frac{c \times x^2}{1 + \sqrt{1 - (k+1) \times x^2 \times c^2}} + a1 \times x + a2 \times x^2 + a3 \times x^3 ....a13 \times x^{13} + a14 \times x^{14}$$

Where: $c = \frac{1}{radius}$ surface of curvature or c = 0 if a flat is described.
x = half the diameter.
z = the sagital point to calculate.

Polynomial derivations of the surface can be quite complex. To help the understanding of their function, the SHAPES.EXE program is provided as a demonstration.