CORNING

Varioptic® Lenses

Application Notes

How to Use A-PE Liquid Lens Zemax Models

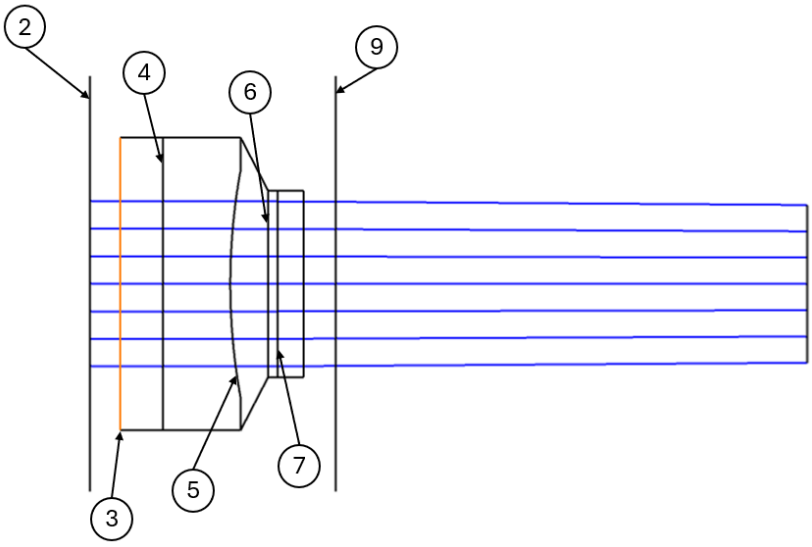
Overview

This document provides some tips on how to use Corning® Varioptic® Lens models in Zemax® OpticStudio® software.

Contents

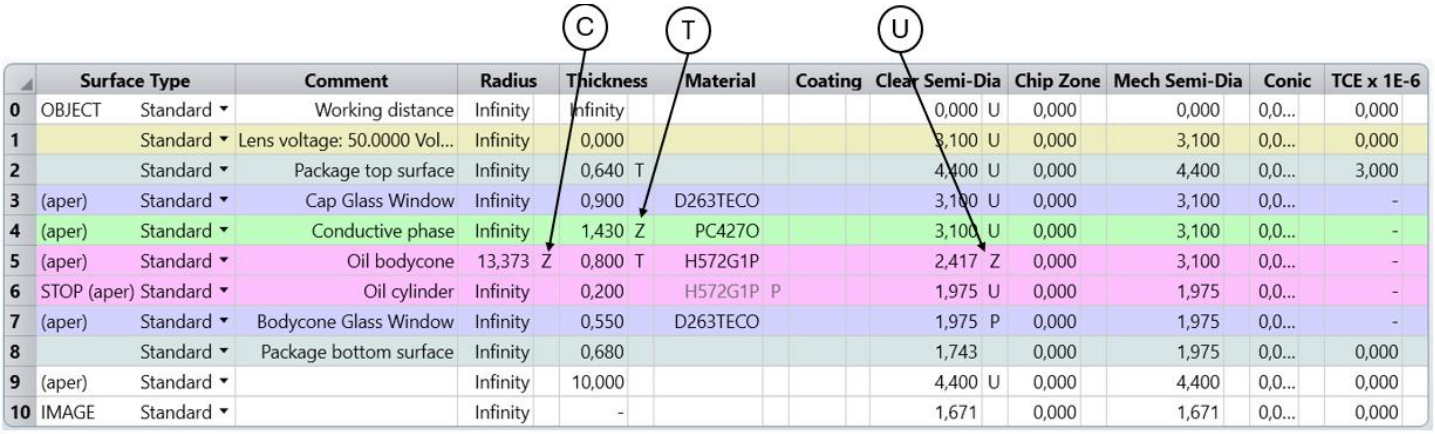
1. General Presentation

A typical Zemax model of an adjustable lens is composed of 8 surfaces, namely the two glass windows (shown below: a Schott glass D263T eco, Surface 3 and 7), the conductive phase (Surface 4), the oil phase in the conical part of the liquid lens (Surface 5) and the oil phase in the cylindrical part (Surface 6). Surface 2 is a virtual surface that represent the package top surface. Surface 9 is the package bottom surface.



Corning uses ZPL macros to fully describe the liquid lens behavior as function of voltage.

This is achieved via three different macros giving the radius of curvature (C), the conductive phase thickness (T) and the semi-diameter (U). Oil thickness calculation is given by performing a thickness solve (a subtraction) based on the value from previous surface. This last value is given by the macro and the total thickness between the windows.



	Surface Type		Comment	Radius	Thickness	Material	Coating	Clear Semi-Dia	Chip Zone	Mech Semi-Dia	Conic	TCE x 1E-6
0	OBJECT	Standard	Working distance	Infinity	Infinity			0,000 U	0,000	0,000	0,0...	0,000
1		Standard	Lens voltage: 50.0000 Vol...	Infinity	0,000			3,100 U	0,000	3,100	0,0...	0,000
2		Standard	Package top surface	Infinity	0,640 T			4,400 U	0,000	4,400	0,0...	3,000
3	(aper)	Standard	Cap Glass Window	Infinity	0,900	D263TECO		3,100 U	0,000	3,100	0,0...	-
4	(aper)	Standard	Conductive phase	Infinity	1,430 Z	PC427O		3,100 U	0,000	3,100	0,0...	-
5	(aper)	Standard	Oil bodycone	13,373 Z	0,800 T	H572G1P		2,417 Z	0,000	3,100	0,0...	-
6	STOP (aper)	Standard	Oil cylinder	Infinity	0,200	H572G1P P		1,975 U	0,000	1,975	0,0...	-
7	(aper)	Standard	Bodycone Glass Window	Infinity	0,550	D263TECO		1,975 P	0,000	1,975	0,0...	-
8		Standard	Package bottom surface	Infinity	0,680			1,743	0,000	1,975	0,0...	0,000
9	(aper)	Standard		Infinity	10,000			4,400 U	0,000	4,400	0,0...	0,000
10	IMAGE	Standard		Infinity	-			1,671	0,000	1,671	0,0...	0,000

1.1. Changing Adjustable Lens Optical Power

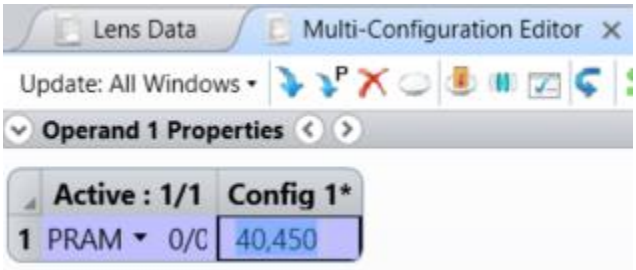


Figure 3

In order to change optical power, the designer must change the voltage used by the macros which is set by the Multi Configuration Editor (MCE, Figure 3). Voltage set in MCE is displayed in the “Comments” cell of surface 2 (Figure 2: number 2). After changing the value and pressing enter, the four variables described in the model will be updated along with the optical power.

1.2. ZPL macro

Each of the macro names can be found by right clicking on the Z letter next to the numerical value (Figure 4 below). In the example below, the macro name for radius of curvature is “C_A25H0”.

This macro has been extracted and copied to the Zemax Macro folder when opening the .zar file provided by Corning.

Figure 4

Each macro is in fact a second order fit of the parameter variation function of the voltage.

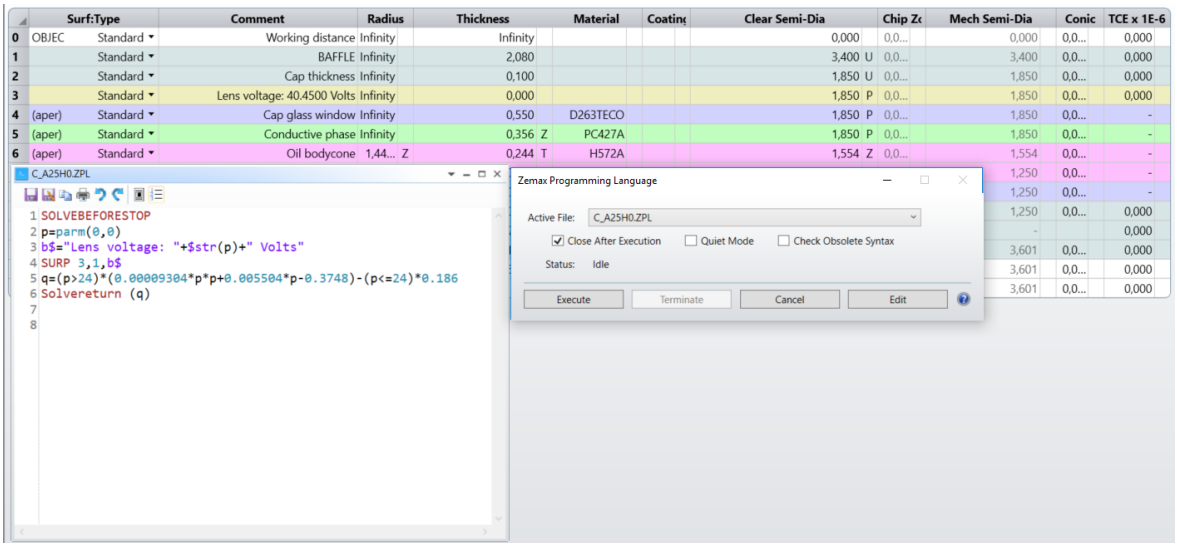


Figure 5

Note: Two additional lines of code are present in the curvature macro. Their purpose is to paste the voltage value set from the Multi Configuration Editor into one of the “Comment” cells.

2. .Zprj File and Potential Version Compatibility Issue

Corning uses Ansys Zemax OpticStudio® 2024 R2.02 and generates Zemax archive files (.zprj) for its customers. This archive includes (in addition to the .zmx file) all macros and glass cat used to model the lens.

The previous version of Zemax might not support ZPL macros or may have problems when placing the optical system stop. Zemax demo version also does not support ZPL macros.

3. Corning® Varioptic® Lenses C-Series Module Zemax Model

Corning also provides Zemax models for all C-Series and C-Cseries modules. These include a black box model of the fixed lens and liquid lens all in one so that customers can simulate directly the full optical stack.

Please note that those models include additional surfaces representing the front and rear end of the lens. This allows the user to directly change the module working distance and/or Mechanical Back Focal Length (MBFL), to correlate simulation with measurement.

Those models also allow a quick evaluation of the module resolution.

	Surf:Type		Comment	Radius	Thickness	Material	Coatin	Clear Semi-Dia	Chip Z	Mech Semi-Dia	Conic	TCE x 1E-6
0	OBJEC	Standard	Working distance	Infinity	Infinity			0,000	0,0...	0,000	0,0...	0,000
1		Standard	BAFFLE	Infinity	2,080			3,400 U	0,0...	3,400	0,0...	0,000
2		Standard	Cap thickness	Infinity	0,100			1,850 U	0,0...	1,850	0,0...	0,000
3		Standard	Lens voltage: 40.4500 Volts	Infinity	0,000			1,850 P	0,0...	1,850	0,0...	0,000
4	(aper)	Standard	Cap glass window	Infinity	0,550	D263TECO		1,850 P	0,0...	1,850	0,0...	-
5	(aper)	Standard	Conductive phase	Infinity	0,356 Z	PC427A		1,850 P	0,0...	1,850	0,0...	-
6	(aper)	Standard	Oil bodycone	1,44... Z	0,244 T	H572A		1,554 Z	0,0...	1,554	0,0...	-
7	(aper)	Standard	Oil cylinder	Infinity	0,100	H572A P		1,250 U	0,0...	1,250	0,0...	-
8	(aper)	Standard	Bodycone Glass Window	Infinity	0,300	D263TECO		1,250 P	0,0...	1,250	0,0...	-
9	STOP	Standard		Infinity	0,800			1,250 U	0,0...	1,250	0,0...	0,000
10	(aper)	Black Box Lens	fix_lens_9-6.ZBB		<7,715>			3,601 U	-	-		0,000
11		Standard	Optical last surface to flange	Infinity	1,800			3,601 P	0,0...	3,601	0,0...	0,000
12		Standard	MBFL thickness value	Infinity	6,120			3,601 P	0,0...	3,601	0,0...	0,000
13	IMAGE	Standard		Infinity	-			3,601 P	0,0...	3,601	0,0...	0,000

Figure 1

Note(s):

1. In some modules, the so called “Optical last surface to flange” value is adjusted to match with the Zemax black box thickness with MBFL value and are therefore not consistent with values measured on the module parts (they can even be negative values in Zemax).
2. Corning does not provide Zemax model data to simulate optical variation with temperature.
3. In the case of microscopy modules, the Zemax model present three different configurations corresponding to the three available module magnifications (config 1=X2; config2= X3; config3= X5).