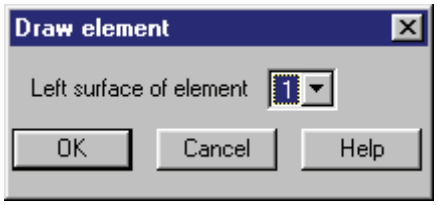
ISO 10110 Element Drawing

ISO 10110 is an international standard titled “Preparation of drawings for optical elements and systems”. It prescribes not only how optical drawings should appear, but also how constructional data and tolerances should be specified. OSLO uses ISO 10110 recommendations for aspheric surface forms, default tolerances, and element drawings. Currently, the element drawing routines are limited to rotationally symmetric lenses with spherical surfaces, specified according to Part 10 of the standard, “Table representing data of a lens element”.

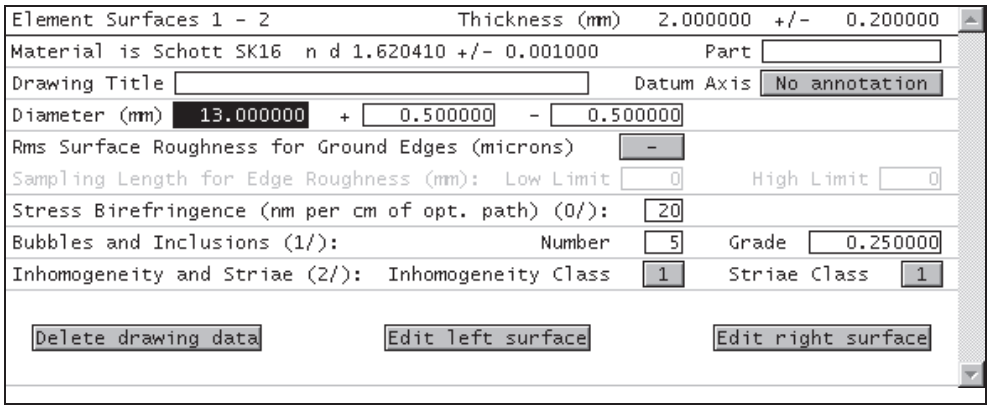
Element drawings are prepared using the Lens >> Lens Drawing >> Element. This command will bring up a dialog box with a drop-down list showing the first surfaces of all the elements in the current lens. If the system contains tilted or reflecting surfaces, the list may not be accurate.



After you select a surface, the program shows a spreadsheet that contains the items that need to be specified for the element as a whole. Most of the fields are set to default values obtained from the lens data, ISO 10110, or the tolerance data. In addition to these sources of data, the address preferences (**ad1-3**) are used to fill in the title block on element drawings.

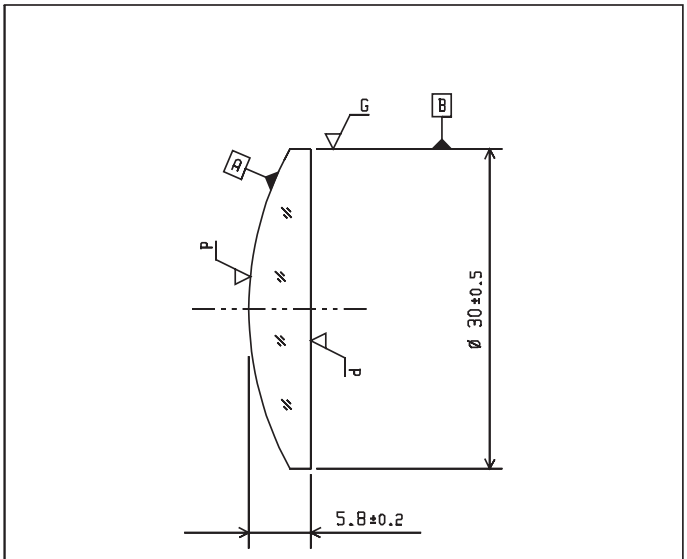
Each field contains an English description of the data to be provided, and where appropriate, a numerical code (e.g. 1/) according to the standard. Some fields have lists that include values recommended in the standard, and these are indicated by buttons.

At the bottom of the initial dialog box are three buttons. The first deletes all element data from a surface (such data is normally stored with the lens). The second and third buttons bring up a dialog box for editing the left and right surfaces of the lens, as shown on the next page. After you have completed any necessary data entry, close the spreadsheet with the Green check, and the drawing will be produced in the current graphics window. For hard copy, you can right-click in the graphics window and print it in the normal way.



Surface 2				Element dimensions are in mm.
Radius 158.650000 CX	+/- 0.000000	Centring Tol. (minutes) (4/)		20.000000
Optically Eff. Diameter	13.000000	Prot. Chamfer	0.200000 -->	0.400000
Surface Polishing Grade	P	Rms Surface Roughness - Rq (nm)		-
Sampling Length for Rq (microns):		Low Limit 0		High Limit 0
Surface Form Deviations - 3/A(B/C):				
A = Sagitta error, B = Irregularity, C = Rotationally symmetric irregularity				
A (fringes) 10.000000	B (fringes) 2.000000	C (fringes)		0.000000
RMS Residual Surface Deviations (3/):				
RMSt = Total rms deviation, RMSi = Rms irregularity, RMSa = Rms asymmetry				
RMSt < 0.000000	RMSi < 0.000000	RMSa <		0.000000
Surface Imperfection Tolerances (5/):				
Surface Imperfections	Number 5	Grade		0.250000
Coating Blemishes	Number 0	Grade		0.000000
Long Scratches	Number 0	Max Width (mm)		0.000000
Edge Chips	Maximum Extent From Edge (mm)			0.000000
Surface Treatment/Coating Specification				
Laser Irradiation Damage Threshold (6/)				

This dialog box is similar to the first, in that default values are obtained from the lens data where possible (if these data are to be changed, they must be changed in the appropriate source, e.g. tolerance data must be changed in the tolerance spreadsheet). The following is a drawing of the single element used for this example.



Left Surface:	Material Specification:	Right Surface:
R 31.123 CX Øe 30.0 Prot. Cham. 0.2 - 0.4 Ⓛ - 3/ 10(2) 4/ 0' 5/ 5x0.25 6/ -	Schott BK7 n d 1.5168±0.001 v - 0/ 20 1/ 5x0.25 2/ 1:1	R ∞ Øe 30.0 Prot. Cham. 0.2 - 0.4 Ⓛ - 3/ 10(2) 4/ 20' 5/ 5x0.25 6/ -

Element Drawing Example		Center for Optics Manufacturing University of Rochester Rochester, New York 14623
A-1996.0306A	Ind. acc. ISO 10110	

The table below gives a brief summary of the data meanings. For additional information, please consult the standard or the OSA ISO 10110 User's Guide.

In the U.S., copies of standards are available from

American National Standards Institute
11 West 42nd Street
New York, NY 10036
tel (212) 642-4900 fax (212) 302-1286

The "OSA User's Guide for ISO 10110" is available from

Optical Society of America
2010 Massachusetts Avenue, NW
Washington, DC 20036
tel (202) 223-8130
fax (202) 223-1096

Summary of ISO 10110 drawing codes

Property and code form	Data
Stress birefringence 0/A	A = Maximum optical path difference (nm/cm)
Bubbles & inclusions 1/NxA	N = Number of bubbles A = Bubble grade number
Inhomogeneity and striae 2/AB	A = Homogeneity class B = Striae class
Surface form tolerance 3/A(B/C) or 3/A(B/C) RMSx < D or 3/- RMSx < D x is either t, i, or a	A = Maximum sagitta error B = Peak-to-valley irregularity C = Non-spherical, rotationally symmetric error D = Maximum rms tolerance t = total rms deviation from nominal surface i = rms irregularity a = rms asymmetry after removal of spherical and rotationally symmetric irregularity A,B,C,D in fringes (default λ= 0.5461μm)
Centering tolerance 4/σ	σ = Surface tilt angle (minutes or seconds)
Surface imperfection tolerance 5/N x A; CN′ x A′; LN″ x A″; EA‴	N = Number of allowed scratches A = Defect grade number (mm) N′ = Number of coating blemishes A′ = Coating blemish grade number (mm) N″ = Number of long scratches (> 2mm) A″ = Maximum width of scratch A‴ = Maximum extent of edge chips (mm)
Laser damage threshold 6/H_{th}; λ; pdg; f_p; n_{ts} x n_p (pulsed) or 6/E_{th}; λ; n_{ts} (cw)	H_{th} = Energy density threshold (J/cm^2) E_{th} = Power density threshold (W/cm^2) λ = Laser wavelength pdg = Pulse duration group f_p = Pulse repetition frequency n_{ts} = Number of test sites n_p = Number of pulses per site